



# CITY OF AUSTIN

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## Hazard Mitigation Plan Update



*Maintaining a Safe, Secure, and Sustainable Community*

Adopted: August 2016



For more information, visit our website at:

<https://austintexas.gov/hsem>

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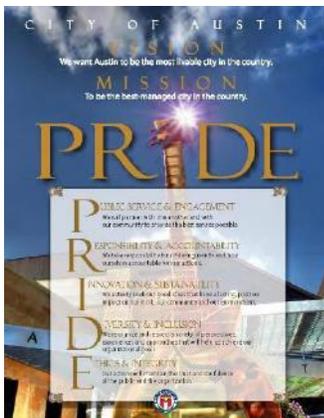
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## Background

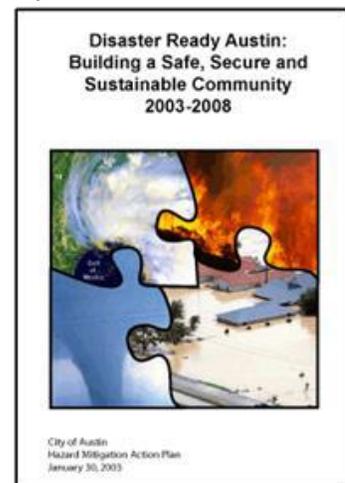
The City of Austin is the Capital of the State of Texas. It is a vibrant community known for the arts, culture, education, and live music. Austinites share a sense of community pride and a determination towards Austin’s vision, to become the most livable city in the country. The City of Austin is committed to providing the highest level of service to its citizens and supports the City of Austin’s vision through: city council priorities; organizational values; comprehensive planning; and corporate initiatives.<sup>1</sup>



Despite the planning mechanisms currently utilized by, the City of Austin is subject to natural, human-caused, and technological hazards. Life-threatening hazards can destroy property, disrupt the economy and lower the overall quality of life for individuals. While it is impossible to prevent an event from occurring, the effect from many hazards to people and property can be lessened. This concept is known as hazard

mitigation, which is defined by the Federal Emergency Management Agency (FEMA) as *sustained actions taken to reduce or eliminate long-term risk to people and property from hazards and their effects.*<sup>2</sup> Communities participate in hazard mitigation by developing hazard mitigation plans. The Texas Division of Emergency Management (TDEM) and FEMA have the authority to review and approve hazard mitigation plans through the Disaster Mitigation Act of 2000.

In 2003, the City of Austin developed its initial Hazard Mitigation Action Plan (HMAP) titled, “Disaster Ready Austin: Building a Safe, Secure and Sustainable Community.” This plan was developed by the City and the Lower Colorado River Authority (LCRA) and was one of the first hazard mitigation plans approved by FEMA in 2004 for the State of Texas.



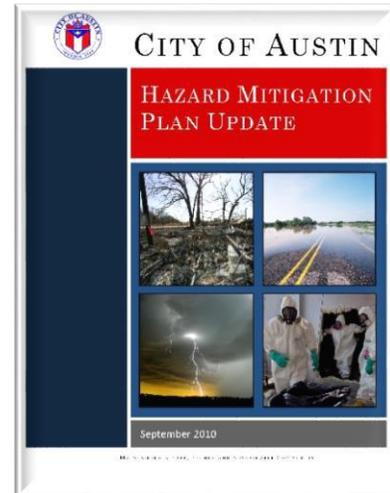
<sup>1</sup> <http://www.austintexas.gov/department/pride-vision-and-values>

<sup>2</sup> <http://www.fema.gov/hazard-mitigation-planning-resources>

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The Disaster Mitigation Act requires that hazard mitigation plans be reviewed and revised every five years to maintain eligibility for Hazard Mitigation Assistance (HMA) grant funding. Since FEMA originally approved the City of Austin HMAP in 2004, the City began the process of developing a HMAP Update in order to maintain eligibility for grant funding within the five-year window by applying for a Hazard Mitigation Grant Program (HMGP) planning grant in 2008. The City of Austin was awarded grant funds in September of 2008 and selected the consultant team of H2O Partners, Inc. and subcontractor Post, Buckley, Schuh & Jernigan, Inc. (PBS&J) to write and develop the HMAP Update. The HMAP Update planning process provided an opportunity for the City of Austin to evaluate successful mitigation actions and explore opportunities to avoid future disaster loss. The HMAP Update was developed for the City of Austin and its extraterritorial jurisdictions, and approved by FEMA in November 2010.<sup>3</sup> The 2010 HMAP Update will expire in November of 2015. Therefore, the City of Austin has selected H2O Partners, Inc. to write and develop the 2016 HMAP Update, hereinafter titled: “City of Austin Hazard Mitigation Plan Update 2016: Maintaining a Safe, Secure and Sustainable Community” (Plan or Plan Update).



Hazard mitigation activities are an investment in a community’s safety and sustainability. It is widely accepted that the most effective hazard mitigation measures are implemented at the local government level, where decisions on the regulation and control of development are ultimately made. A comprehensive update to a hazard mitigation plan addresses hazard vulnerabilities that exist today and in the foreseeable future. Therefore, it is essential that a plan identify projected patterns of how future development will increase or decrease a community’s overall hazard vulnerability.



The Office of Homeland Security and Emergency Management (HSEM) is responsible for overseeing the development of the Plan Update for the City of Austin. The Vision of HSEM is to continually develop and maintain a “Disaster Ready Austin,” where the whole community

cooperates to ensure the evolving City of Austin is resilient and prepared for all hazards.<sup>4</sup>

## Scope and Participation

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The City of Austin and the Austin Independent School District (AISD) are the only participants for the 2016 Plan Update. Other entities and businesses, including The University of Texas, Austin Community College, Capital Metro, and the Red Cross, participated as stakeholders and provided valuable input into the planning process.

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<sup>3</sup> <http://www.austintexas.gov/department/emergency-operations>

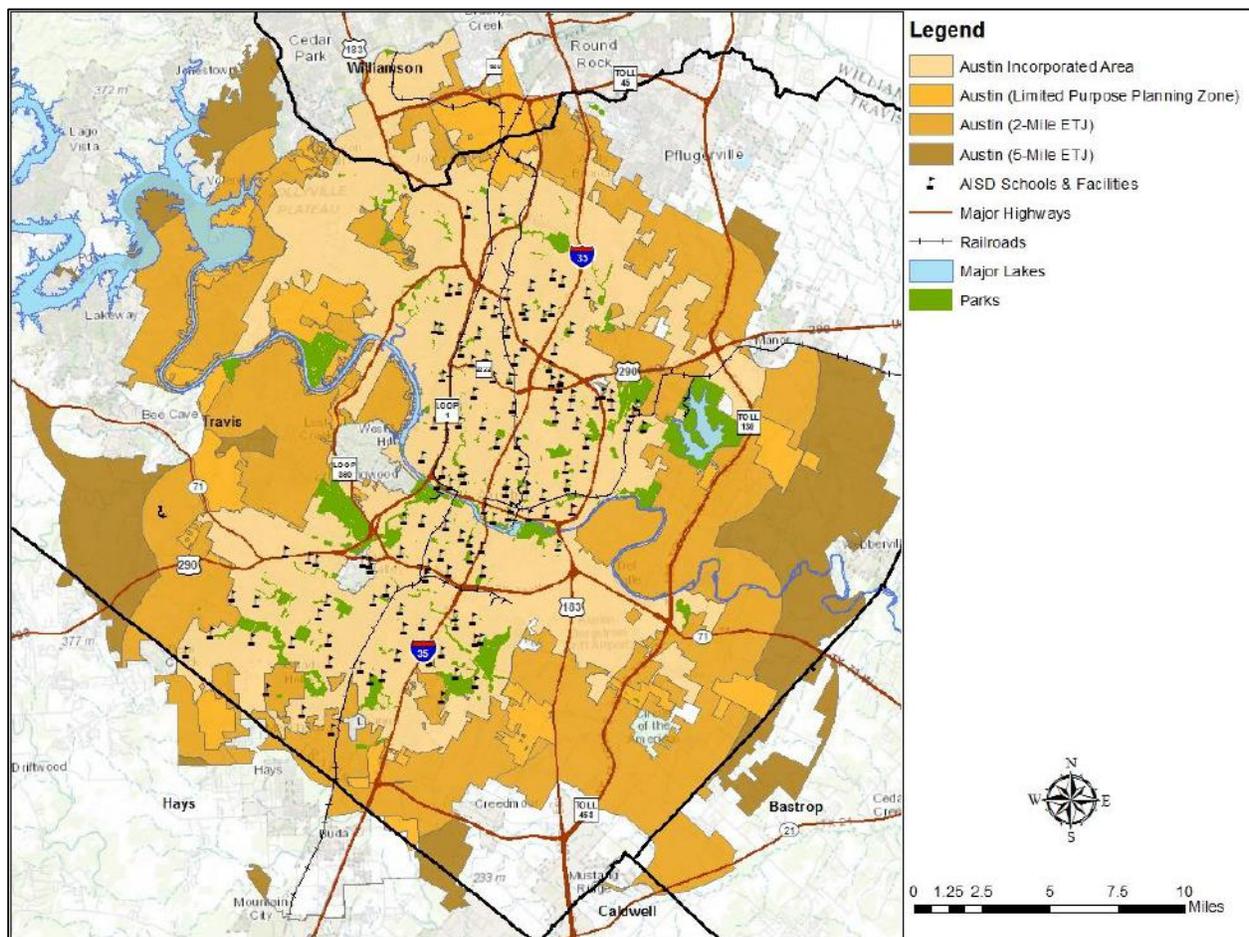
<sup>4</sup> <http://www.austintexas.gov/department/about-hsem>

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The focus of the 2016 Plan Update is to identify activities to mitigate hazards classified as “high” or “moderate” risk, as determined through a detailed hazard risk assessment conducted for the City of Austin and Austin ISD. Hazards that pose a “low” or “negligible” risk will continue to be evaluated during future updates to the Plan, but may not be fully addressed until they are determined to be a high or moderate risk. The hazard classification enables the City and Austin ISD to prioritize mitigation actions based on hazards which can present the greatest risk to lives and property in the geographic scope (i.e., planning area).

The planning area for the Plan Update includes all areas within the City of Austin and its Extraterritorial Jurisdictions (ETJ) as displayed in Figure 1-1 below. The ETJ is the unincorporated land within five miles of the City of Austin’s boundary that is not within the City limits or ETJ of another city. It is the territory where the City of Austin alone is authorized to annex land. The ETJ enables the City of Austin to extend regulations to adjacent land where development can affect quality of life within the City.

**Figure 1-1. Area Covered in the Plan Update**



## Purpose

The 2016 Plan Update was prepared by the City of Austin, AISD, and H2O Partners, Inc. The purpose of the Plan Update is to protect people and structures, and to minimize the costs of disaster response and recovery. The goal of the Plan Update is to minimize or eliminate long-term risks to human life

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and property from known hazards by identifying and implementing cost-effective hazard mitigation actions. The planning process is an opportunity for the City of Austin, AISD, stakeholders, and the general public to evaluate and develop successful hazard mitigation actions to reduce future risk of loss of life, and damage to property resulting from a disaster in the City of Austin.

The Mission Statement of the Plan Update is, *“Maintaining a secure and sustainable future through the revision and development of targeted hazard mitigation actions to protect life and property.”*

The City of Austin, AISD, and planning participants identified ten natural hazards and seven technological and human-caused hazards to be addressed by the Plan Update. The specific goals of the Plan Update are to:

- Provide a comprehensive update to the 2010 HMAP;
- Minimize disruption to the City of Austin and AISD following a disaster;
- Streamline disaster recovery by articulating actions to be taken before a disaster strikes to reduce or eliminate future damage;
- Demonstrate a firm local commitment to hazard mitigation principles;
- Serve as a basis for future funding that may become available through grant and technical assistance programs offered by the State or Federal government. The Plan Update will enable the City of Austin and AISD to take advantage of rapidly developing mitigation grant opportunities as they arise; and
- Ensure that the City of Austin and AISD maintain eligibility for the full range of future Federal disaster relief.

## Authority

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The Plan Update is tailored specifically for the City of Austin, Austin ISD, and plan participants including Planning Team members, stakeholders, and the general public who participated in the Plan Update development process. The Plan Update complies with all requirements promulgated by the Texas Division of Emergency Management (TDEM) and all applicable provisions of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390), and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 (P.L. 108-264), which amended the National Flood Insurance Act (NFIA) of 1968 (42 U.S.C. 4001, et al). Additionally, the Plan complies with the Interim Final Rules for the Hazard Mitigation Planning and Hazard Mitigation Grant Program (44 CFR, Part 201), which specify the criteria for approval of mitigation plans required in Section 322 of the DMA 2000 and standards found in FEMA’s “Local Mitigation Plan Review Guide” (October 2011), and the “Local Mitigation Planning Handbook” (March 2013). Additionally, the Plan is developed in accordance with FEMA’s Community Rating System (CRS) Floodplain Management Plan standards and policies.

## Summary of Sections

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Sections 1 and 2 of the Plan Update outline the Plan’s purpose and development, including how Planning Team members, stakeholders, and members of the general public were involved in the planning process. Section 3 profiles the planning area’s population and economy. Sections 4 through

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21 present a hazard overview and information on individual, natural, technological and human-caused hazards in the planning area. The hazards generally appear in order of priority based on potential losses to life and property, and other community concerns. For each hazard, the Plan Update presents a description of the hazard, a list of historical hazard events, and the results of the vulnerability and risk assessment process. Section 22 presents hazard mitigation goals and objectives, Section 23 gives an analysis for the previous actions and Section 24 presents hazard mitigation actions for the City of Austin and AISD. Section 25 identifies Plan maintenance mechanisms.

A list of Planning Team members is located in Appendix A. Public survey results are analyzed and presented in Appendix B. Appendix C contains a detailed list of critical facilities for the planning area, and Appendix D provides a list of dam locations. Appendix E contains information regarding workshops, meeting documentation, and the Capability Assessment for the City of Austin is located in Appendix F.<sup>5</sup>



<http://www.city-data.com/picfilesc/picc77173.php>

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<sup>5</sup> Information contained in some of these appendices are exempt from public release under the Freedom of Information Act (FOIA).

<sup>6</sup> Picture provided by <http://www.city-data.com/picfilesc/picc77173.php>

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## Plan Preparation and Development

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Hazard mitigation planning involves coordination with various constituents and stakeholders to develop a more disaster-resistant community. Section 2 provides an overview of the planning process including the identification of key steps, and a detailed description of how stakeholders and the public were involved.

### Overview of the Plan

The City of Austin hired H2O Partners, Inc. (Consultant Team), to provide technical support and oversee the development of the Plan Update. The Consultant Team used the FEMA “Local Mitigation Plan Review Guide” (October 1, 2011), and the “Local Mitigation Planning Handbook” (March 2013) to develop the Plan. The overall planning process is shown in Figure 2-1 below.

**Figure 2-1. Mitigation Planning Process**



The City of Austin, AISD, and the Consultant Team met in March 2015 to begin organizing resources, identify Planning Team members, and conduct a Capability Assessment.

### Planning Team

Key members of H2O Partners, Inc. developed the Plan Update in conjunction with the Planning Team. The Planning Team was established using a direct representation model. Some of the responsibilities of the Planning Team included: completing Capability Assessment surveys, providing input regarding the identification of hazards, identifying mitigation goals, and developing mitigation strategies. An Executive Planning Team from the City of Austin Office of Homeland Security and Emergency Management, shown in Table 2-1, was formed to coordinate planning efforts, and request input and participation in the planning process. Table 2-2 reflects the Advisory Planning Team, consisting of representatives from area organizations and departments for the City of Austin and Austin Independent School District (AISD) that participated throughout the planning process.

Additionally, a large Stakeholder Working Group was invited to participate in the planning process via e-mail, and met on a monthly basis. The Consultant Team, Planning Team, and Stakeholder Working Group coordinated to identify mitigation goals, and develop mitigation strategies and actions for the Plan Update. Appendix A, provides a complete listing of all participating Planning Team members and stakeholders by organization and title.

Based on results of completed Capability Assessment, the City of Austin and AISD described methods for achieving future hazard mitigation measures by expanding existing capabilities. For example, AISD has an Evacuation Plan in place for evacuating students during a disaster, but no shelter-in-place in the event of tornado. Other options for improving capabilities include the following:

- Establishing Planning Team members with the authority to monitor the Plan Update and identify grant funding opportunities for expanding staff.

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- Identifying opportunities for cross-training or increasing the technical expertise of staff by attending free training available through FEMA and the Texas Division of Emergency Management (TDEM) by monitoring classes and availability through [preparetexas.org](http://preparetexas.org).
- Reviewing current floodplain ordinances for opportunities to increase resiliency such as modifying permitting or building codes.
- Developing ordinances that will require all new developments to conform to the highest mitigation standards.

Sample hazard mitigation actions developed with similar hazard risk were shared at the meetings. These important discussions resulted in development of multiple mitigation actions that are included in the Plan Update to further mitigate risk from natural hazards in the future.

The Planning Team developed hazard mitigation actions for mitigating risk from potential flooding and wildfire, including promoting the FireWise program, practicing hazard mitigation techniques, and retrofitting current facilities to mitigate flood water damage. In order to reduce the damage resulting from city-wide flooding that occurs during heavy rain periods, the Plan Update also includes city-wide actions to construct scour and erosion protection of bridges and culverts with high scour potential.

**Table 2-1. Executive Planning Team**

DEPARTMENTS	TITLE
Office of Homeland Security & Emergency Management	Director
Office of Homeland Security & Emergency Management	Sr. Emergency Plans Officer
Office of Homeland Security & Emergency Management	Accountant
Office of Homeland Security & Emergency Management	Public Information & Marketing Program Manager
Office of Homeland Security & Emergency Management	Public Information Specialist
Office of Homeland Security & Emergency Management	Community Preparedness Program Coordinator
Office of Homeland Security & Emergency Management	Administrative Manager, Administration & Finance Programs

**Table 2-2. Advisory Planning Team**

DEPARTMENTS	TITLE
Austin Fire Department	Fire Captain
Austin Fire Department	Fire Adapted Communities Coordinator
Austin/Travis County Health & Human Services Department	Chief Epidemiologist
Austin/Travis County Health & Human Services Department	Epidemiologist

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DEPARTMENTS	TITLE
Austin Independent School District	Emergency Management Coordinator
Austin Police Department	Sergeant
Austin – Travis County Emergency Medical Services	Division Chief - Emergency Management
Communications & Technology Management	Security
Communications & Technology Management	Information Systems Division Manager
Geographic Information Systems	Programmer Analyst Supervisor
Historic Landmark Commission	Planning
Office of Sustainability	Environmental Program Coordinator
Planning and Development Review Department	Principal Planner
Public Works Department	City Engineer
Public Works Department	Supervising Engineer
Public Works Department	Consulting Engineer
Watershed Protection Department	Program Manager, Environmental Conservation

### Planning Process

The process used to prepare the 2015 Plan Update followed the four major steps included at Figure 2-1. After the Planning Team was organized, a capability assessment was developed and distributed at the Kick-Off Workshop. Hazards were identified and assessed, and results associated with each of the hazards were provided at the Risk Assessment Workshop. Based on the City of Austin’s identified vulnerabilities, specific mitigation strategies were discussed and developed at the Mitigation Strategy Workshop. Finally, Plan maintenance and implementation procedures were developed and are included in Section 25. Participation of Planning Team members, stakeholders, and the public at each of the workshops is documented in Appendix E.

At the Plan Update development workshops held throughout the planning process described herein, the following factors were taken into consideration:

- The nature and magnitude of risks currently affecting the community;
- Hazard mitigation goals to address current and expected conditions;
- Whether current resources will be sufficient for implementing the Plan Update;
- Implementation problems, such as technical, political, legal, and coordination issues that may hinder development;
- Anticipated outcomes; and

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- How the City of Austin, AISD, agencies, and partners will participate in implementing the Plan Update.

### Kickoff Workshop

The Kickoff Workshop was held at the City of Austin HSEM Offices on March 10, 2015. The initial workshop informed City officials, key department personnel, and AISD about how the planning process pertained to their distinct roles and responsibilities, and engaged stakeholder groups such as the Capital Area Metropolitan Planning Organization (CAMPO) and area universities. In addition to the kickoff presentation, participants received the following information:

- Project overview regarding the planning process;
- Public survey access information;
- Hazard Ranking form; and
- Capability Assessment survey for completion.

A risk ranking exercise was conducted at the Kickoff Workshop to get input from the Planning Team and stakeholders pertaining to various risks from a list of natural hazards affecting the planning area. Participants ranked hazards high to low in terms of perceived level of risk, frequency of occurrence, and potential impact.

### Hazard Identification

At the Kickoff Workshop, and through e-mail and phone correspondence, the Planning Team conducted preliminary hazard identification. The Planning Team in coordination with the Consultant Team reviewed and considered a full range of natural and man-caused hazards. Once identified, the teams narrowed the list to significant hazards by reviewing hazards affecting the area as a whole, the 2013 State of Texas Hazard Mitigation Plan Update, and initial study results from reputable sources such as federal and state agencies. Based on this initial analysis, the teams identified a total of ten natural hazards and seven technological, or human-caused hazard, which pose a significant threat to the planning area.

### Risk Assessment

An initial risk assessment for the City of Austin and AISD was completed in April 2015 and results were presented to Planning Team members at the Risk Assessment Workshop held on April 28, 2015. At the workshop, the characteristics and consequences of each hazard were evaluated to determine the extent to which the planning area would be affected in terms of potential danger to property and citizens.

Potential dollar losses from each hazard were estimated using the Federal Emergency Management Agency's Hazards U.S. Multi-Hazards (MH) Model (HAZUS-MH) and other HAZUS-like modeling techniques. The assessments examined the impact of various hazards on the built environment, including general building stock (e.g., residential, commercial, industrial), critical facilities, lifelines, and infrastructure. The resulting risk assessment profiled hazard events, provided information on previous occurrences, estimated probability of future events, and detailed the spatial extent and magnitude of impact on people and property. Each participant at the Risk Assessment Workshop was provided a risk ranking sheet that asked participants to rank hazards in terms of the probability or frequency of occurrence, extent of spatial impact, and the magnitude of impact. The results of the ranking sheets identified unique perspectives on varied risks throughout the planning area.

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The assessments were also used to set priorities for hazard mitigation actions based on potential loss of lives and dollar losses. A hazard profile and vulnerability analysis for each of the hazards can be found in Sections 4 through 21.

### Mitigation Review and Development

Developing the Mitigation Strategy for the Plan Update involved identifying mitigation goals and new mitigation actions. A Mitigation Workshop was held at the City of Austin HSEM Offices on August 4, 2015. In addition to the Planning Team, stakeholder groups were invited to attend the workshop. Regarding hazard mitigation actions, Workshop participants emphasized the desire for flood and wildfire projects. Additionally, the City and ISD were proactive in identifying mitigation actions to lessen the risk of all the identified hazards included in the Plan.

An inclusive and structured process was used to develop and prioritize new hazard mitigation actions for the 2015 Plan Update. The prioritization method was based on FEMA's STAPLE+E criteria and included social, technical, administrative, political, legal, economic and environmental considerations. As a result, each Planning Team Member assigned an overall priority to each hazard mitigation action. The overall priority of each action is reflected in the hazard mitigation actions found in Section 24.

Planning Team Members then developed action plans identifying proposed actions, costs and benefits, the responsible organization(s), effects on new and existing buildings, implementation schedules, priorities, and potential funding sources.

Specifically the process involved:

- Listing optional hazard mitigation actions based on information collected from previous plan reviews, studies, and interviews with federal, state and local officials. Workshop participants reviewed the optional mitigation actions and selected actions that were most applicable to their area of responsibility, cost-effective in reducing risk, easily implemented, and likely to receive institutional and community support.
- Workshop participants inventoried federal and state funding sources that could assist in implementing the proposed hazard mitigation actions. Information was collected, including the program name, authority, purpose of the program, types of assistance and eligible projects, conditions on funding, types of hazards covered, matching requirements, application deadlines, and a point of contact.
- Planning Team Members considered the benefits that would result from implementing the hazard mitigation actions compared to the cost of those projects. Although detailed cost-benefit analyses were beyond the scope of the Plan Update, Planning Team Members utilized economic evaluation as a determining factor between hazard mitigation actions.
- Planning Team Members then selected and prioritized mitigation actions.

Hazard mitigation actions identified in the process were made available to the Planning Team for review. The draft 2016 Plan Update was made available to the general public for review and comment on the City of Austin's website.

### Review and Incorporation of Existing Plans

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#### Review

Background information utilized during the planning process included various studies, plans, reports, and technical information from sources such as FEMA, the United States Army Corps of Engineers (USACE), the U.S. Fire Administration, National Oceanic and Atmospheric Administration (NOAA), the Texas Water Development Board (TWDB), the Texas Commission on Environmental Quality (TCEQ), the Austin/Travis County Health and Human Services Department (A/TCHHSD), the Texas State Data Center, Texas Forest Service, the Texas Division of Emergency Management (TDEM), and local hazard assessments and plans. Section 4 and the hazard-specific sections of the Plan (Sections 5-21) summarize the relevant background information.

Specific background documents, including those from FEMA, provided information on hazard risk, hazard mitigation actions currently being implemented, and potential mitigation actions. Previous hazard events, occurrences and descriptions were identified through NOAA's National Climatic Data Center (NCDC) and Austin/Travis County Health and Human Services Department. Results of past hazard events were found through searching the NCDC. The USACE studies were reviewed for their assessment of risk and potential projects in the region. State Data Center documents were used to obtain population projections. The State and City of Austin Demographer webpages were reviewed for population and other projections and included in Section 3 of the Plan Update. Information from the Texas Forest Service was used to appropriately rank the wildfire hazard, and to help identify potential grant opportunities. Materials from FEMA and TDEM were reviewed for guidance on Plan Update development requirements.

#### Incorporating Existing Plans into the HMAP Process

A Capability Assessment was completed by key City of Austin and AISD departments which provided information pertaining to existing plans, policies, ordinances and regulations to be integrated into the goals and objectives of the Plan Update. The relevant information was included in a master Capability Assessment, Appendix F.

Existing projects and studies were utilized as a starting point for discussing hazard mitigation actions among Planning and Consultant Team members. For example, the City of Austin has completed an Extreme Weather Vulnerability Assessment to assist in planning future growth initiatives and safe growth objectives for the community including, quality land development, and preservation of the community's unique historic and environmental features. The City of Austin's Comprehensive Plan is incorporated into the Plan Update as it pertains to mitigating risk from natural disasters and the resulting effects on transportation, and development in floodplain areas; and educating residents on how to protect themselves and their property. Additionally, mitigation actions from other plans were reviewed, such as Floodplain Management Plans and Stormwater Management Plans. Finally, the 2013 State of Texas Mitigation Plan Update, developed by TDEM, was discussed in the initial planning meeting in order to develop a specific group of hazards to address in the planning effort. The 2013 State Plan Update was also used as a guidance document, along with FEMA materials, in the development of the City of Austin Plan Update.

#### Incorporation of the HMAP into Other Planning Mechanisms

Planning Team members will integrate implementation of the Plan Update with other planning mechanisms for the City of Austin, such as the Emergency Management Plan. Existing plans for the

## Section 2: Planning Process

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City of Austin will be reviewed, and incorporated into the Plan Update, as appropriate. This section discusses how the Plan Update will be implemented by the City of Austin and AISD. It also addresses how the Plan Update will be evaluated and improved over time, and how the public will continue to be involved in the hazard mitigation planning process.

The budget process allocates resources and prioritizes the needs of a local jurisdiction, school district, or other organization, and is a major element to incorporating existing studies and other planning mechanisms into the Plan Update. For a governmental entity, the budget often represents the legal authority to spend money, and is an opportunity to optimize resources found in existing planning mechanisms with hazard mitigation objectives and goals. The Annual Budget Review is an important tool to execute mitigation goals and objectives, and provide funding for identified hazard mitigation actions. The identified contact persons for the City of Austin and AISD, will participate in the budgetary process to track identified hazard mitigation actions, recommend prioritization for grant funding, and update and maintain the mitigation strategy developed for the City of Austin and AISD.

The City of Austin and AISD will be responsible for implementing hazard mitigation actions contained in Section 24. Each hazard mitigation action has been assigned to a specific City and AISD department that is responsible for tracking and implementing the action.

A funding source has been listed for each identified hazard mitigation action and may be utilized to implement the action. An implementation time period has also been assigned to each hazard mitigation action as an incentive and to determine whether actions are implemented on a timely basis.

The City of Austin and AISD will integrate hazard mitigation actions contained in the Plan Update with existing planning mechanisms such as the Capital Improvement Plans, long range Comprehensive Development Plans, Master Storm Water and Drainage Plans, Flood Studies, Emergency Operations or Management Plans, and other local and area planning efforts. The City of Austin will work closely with Travis County, and other area organizations to coordinate implementation of hazard mitigation actions that benefit the planning area in terms of financial and economic impact.

Upon formal adoption of the Plan Update, Planning Team members from the City of Austin and AISD will review existing plans, along with building codes to guide development and ensure that hazard mitigation actions are implemented. Both the City of Austin and AISD will be responsible for coordinating periodic review of the Plan Update with members of the Advisory Planning Team to ensure integration of hazard mitigation strategies into these planning mechanisms and codes. The Planning Team will also conduct periodic reviews of various existing planning mechanisms and analyze the need for any amendments or updates in light of the approved Plan Update. The City of Austin and AISD will ensure that future long-term planning objectives will contribute to the goals of the Plan Update to reduce the long-term risk to life and property from moderate and high risk hazards. Within one year of formal adoption of the Plan Update, existing planning mechanisms will be reviewed and analyzed as they pertain to the Plan Update.

Planning Team members will review and revise, as necessary, the long-range goals and objectives in its strategic plan and budgets to ensure that they are consistent with the Plan Update.

Further, the City of Austin will work with neighboring jurisdictions to advance the goals of the Plan Update as it applies to ongoing, long-range planning goals and actions for mitigating risk to natural hazards throughout the planning area.

Table 2-3 identifies types of planning mechanisms and examples of methods for incorporating the Plan Update into other planning efforts.

## Section 2: Planning Process

**Table 2-3. Example of Methods of Incorporation**

PLANNING MECHANISM	METHOD OF INCORPORATION
Grant Applications	The City of Austin and AISD will consult the Plan Update whenever there are yearly grant funding cycles available through FEMA, including the Pre-Disaster Mitigation (PDM) cycle, and when there is a Disaster Declaration for Texas triggering Hazard Mitigation Grant Program (HMGP) funds. Hazard mitigation actions for each jurisdiction will be reviewed by the Planning Team members and information will be updated for completing applications, such as maps and risk assessment data. If a project is not in the Plan Update, an amendment may be developed.
Annual Budget Review	The City of Austin and AISD will review the Plan Update and hazard mitigation actions therein when conducting its annual budget review. When allocating funds for upcoming operating and construction budgets, high priority hazard mitigation actions will be reviewed during City Council/School Board meetings. Each identified staff member/Planning Team member will be responsible for bringing hazard mitigation actions to the meeting to discuss feasibility of the potential project in terms of the availability of funds, grant assistance, and preliminary cost benefit review.
Emergency Planning	The Plan Update will be consulted during updates to the local emergency and/or disaster recovery plan. Risk assessment and vulnerability data will be pulled from the Plan Update and analyzed in conjunction with the review, renewal, or re-writing of an Emergency Operations or Management Plan. This data will either be included within the new emergency planning mechanism or included as an appendix. Hazard mitigation actions that relate to prevention and protection will also be reviewed for relevance to determine if they should be included.
Comprehensive/Capital Improvements	Before any updates to the Comprehensive/Capital Improvement Plans (CIP) are conducted, the City of Austin will review the Risk Assessment and Mitigation Strategy sections of the Plan Update, as limiting public spending in hazardous zones is one of the most effective long-term hazard mitigation actions available to local governments. Profile information and data regarding NFIP compliance and maintenance will be reviewed in conjunction with any CIP that is developed. If new census or land use data is available, this information should be added to the Plan Update.
Floodplain Management Plan and Fire Protection	The Plan Update will be utilized in updating and maintaining floodplain management and fire protection plans, as the goals of both planning mechanisms are similar. In updating or maintaining these plans, the Plan Update will be consulted for NFIP compliance, flood risk, wildfire risk, and extent. Information from these sections will be reviewed for inclusion. In addition, hazard mitigation actions that address wildfire and flood will be reviewed for inclusion.

## Section 2: Planning Process

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Appendix F provides an overview of Planning Team members' existing planning and regulatory capabilities to support implementation of mitigation strategy objectives. Appendix F also provides further analysis of how each intends to incorporate hazard mitigation actions into existing plans, policies, and the annual budget review as it pertains to prioritizing grant applications for funding and implementation of identified hazard mitigation projects.

### Plan Review and Plan Update

As with the development of Plan Update, the City of Austin will oversee the review and update process for relevance and to necessary make adjustments. At the beginning of each fiscal year, Team Members will meet to evaluate the Plan Update and review other planning mechanisms to ensure consistency with long-range planning efforts. In addition, planning participants will also meet twice a year, by conference call or presentation, to re-evaluate prioritization of the hazard mitigation actions. Annual meeting to receive feedback on EOP. This is at city hall and publicized in advance. Will combine. EOP is reviewed each year at the same time – need exact date from Billy.

### Timeline for Implementing Mitigation Actions

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Both the Executive Planning Team (Table A-1, Appendix A), and the Advisory Planning Team (Table A-2, Appendix A), will engage in discussions regarding a timeframe for how and when to implement each hazard mitigation action. Considerations include when the action will be started, how existing planning mechanisms' timelines affect implementation, and when the action should be fully implemented. Timeframes may be general, and there will be short, medium, and long term goals for implementation based on prioritization of each action, as identified on individual Hazard Mitigation Action worksheets included in the Plan Update for the City of Austin and AISD.

Both the Executive and Advisory Planning Team will evaluate and prioritize the most suitable hazard mitigation actions for the community to implement. The timeline for implementation of actions will partially be directed by the City of Austin's comprehensive planning process, Capital Improvements Plan, budgetary constraints, and community needs. The City of Austin and AISD are committed to addressing and implementing hazard mitigation actions that may be aligned with and integrated into the Plan Update.

Overall, the Planning Team is in agreement that goals and actions of the Plan Update shall be aligned with the timeframe for implementation of hazard mitigation actions with respect to annual review and updates of existing plans and policies.

### Public and Stakeholder Involvement

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An important component of hazard mitigation planning is public participation and stakeholder involvement. Input from individual citizens and the community as a whole provides the Planning Team with a greater understanding of local concerns, and increases the likelihood of successfully implemented hazard mitigation actions. If citizens and stakeholders, such as local businesses, non-profits, hospitals, and schools are involved, they are more likely to gain a greater appreciation of the risks that hazards may present in their community and take steps to reduce or mitigate their impact.

The public was involved in the development of the City of Austin's 2016 Plan Update at different stages prior to official Plan Update approval and adoption. Public input was sought using three methods: (1)

## Section 2: Planning Process

open public meetings; (2) survey instruments; and (3) making the draft Plan Update available for public review at the City of Austin’s website.

The draft 2016 Plan Update was made available to the general public for review and comment on the City of Austin’s website. The public was notified at the public meetings that the draft Plan Update would be available on the City’s website. No feedback was received on the draft Plan Update, although it was given on the public survey, and all relevant information was incorporated into the Plan Update.

The 2016 Plan Update will be advertised and posted on the City of Austin’s website upon approval from FEMA. Stakeholder Involvement

Stakeholder involvement is essential to hazard mitigation planning since a wide range of stakeholders can provide input on specific topics and input from various points of view. Throughout the planning process, members of community groups, local businesses, neighboring jurisdictions, schools, and hospitals were invited to participate in development of the 2016 Plan Update. The “Stakeholder Working Group” (Table A-3 in Appendix A, and Table 2-4, below), included a broad range of representatives from both the public and private sector, and served as a key component in the City of Austin’s outreach efforts for development of the Plan Update. Documentation of stakeholder meetings is found in Appendix E. A list of organizations invited to attend via e-mail is found in Table 2-4.

**Table 2-4. Stakeholder Working Group**

AGENCY	TITLE	PARTICIPATED
Austin Community College (ACC)	Emergency Management Coordinator	X
Austin/Travis County Integral Care	Coordinator, Disaster Mental Health	
Capital Area Council of Governments (CAPCOG)	Director, Homeland Security	X
Capital Area Council of Governments (CAPCOG)	Homeland Security Planning Coordinator	X
Capital Area Metropolitan Planning Organization (CAMPO)	Planner	X
Capital Area Metropolitan Planning Organization (CAMPO)	Air Quality Program Manager	X
Capital Area Trauma Regional Advisory Council (CATRAC)	Executive Director	
Capital Metro	Quality Control Specialist	X
Red Cross	Disaster Services Chair	
Travis County Medical Society	Chief Operating Officer	
University of Texas	Director, Campus Security	

Stakeholders and participants from neighboring communities that attended the Planning Team and public meetings played a key role in the planning process. For example, the Austin Police Department identified the need for an Uninterrupted Power Source (UPS) for their Main Station. The Department

## Section 2: Planning Process

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Operations Center is located in the Main Station which lost connectivity at a crucial time while coordinating public safety response efforts during the Memorial Day flooding event, DR-4223, which occurred May 04, 2015 to June 22, 2015.

### Public Meetings

A series of public meetings were held at local library branches throughout the planning area, to collect public and stakeholder input. Topics of discussion included the purpose of hazard mitigation, discussion of the planning process, and types of natural and human-caused hazards. Representatives from area neighborhood associations, and area residents were invited to participate. Additionally, the City of Austin utilized social media sources including Facebook, Twitter, and the local media to increase public participation in the Plan Update development process. The City of Austin also posted notices of meetings at City Hall and kiosks in public gathering places. Documentation on the public meetings are found in Appendix E.

Public meetings were held on the following dates and locations:

- March 10, 2015, Pleasant Hill Branch Library
- March 12, 2015, Howson Branch Library & Spicewood Springs Branch Library
- March 16, 2015, Carver Branch Library
- July 13, 2015, Pleasant Hill Branch Library & Spicewood Springs Branch Library
- July 16, 2015, Howson Branch Library & Carver Branch Library

### Public Participation Survey

In addition to public meetings, the Planning and Consultant Teams developed a public survey designed to solicit public input during the planning process from citizens and stakeholders, and to obtain data regarding the identification of any potential hazard mitigation actions or problem areas. The survey was promoted by local officials and a link to the survey was posted on the City of Austin's website. A total of 158 surveys were completed online, and an additional 12 surveys were completed at public meetings. The survey results are analyzed in Appendix B. The City of Austin reviewed the input from the surveys and decided which information to incorporate into the Plan Update as hazard mitigation actions. For example, many citizens mention concerns about flooding, watershed protection, and the effects of increasing development, including development in areas that are flood-prone. In response to public input several hazard mitigation actions were added to the Plan Update to control flooding and increase watershed protection by implementing a program to inspect bridges and culverts and constructing scour and erosion protection where needed.

# Section 3: Community Profile

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## Overview

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Section 3 provides an overall description of the City of Austin and the Austin Independent School District (AISD), including available data on the following:

- History and Government;
- Geography and the Environment;
- Population and Demographics;
- Housing and Household Income; and
- Economy and Industry

## History and Government

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The City of Austin, founded in 1839, is the capital of Texas and the county seat for Travis County.

For hundreds of years, nomadic tribes of Tonkawa, Comanche, and Lipan Apaches camped and hunted along the creeks, including what is now known as Barton Springs. In the late 1700s, the Spanish set up temporary missions in the area. In the 1830s, the first permanent Anglo settlers arrived and called their village Waterloo.

In 1839, Waterloo was chosen to be the capital of the new Republic of Texas. A new city was built quickly in the wilderness, and was named after Stephen F. Austin, "the father of Texas." Judge Edwin Waller, who was later to become the City's first mayor, surveyed the site and laid out a street plan that has survived largely intact to this day. In October 1839, the entire government of the Republic arrived from Houston in oxcarts. By the next January, the town's population had grown to 856 people. The new town plan included a hilltop site for a capitol building looking down toward the



*Congress Avenue, Early 20<sup>th</sup> Century. Source: Austin History Center*

Colorado River from the head of a broad Congress Avenue. For over 150 years, "The Avenue" and

## Section 3: Community Profile

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Pecan Street (now 6th Street) have remained Austin's principal business streets. After Texas was annexed by the United States in 1845, it took two statewide elections to keep Austin the capital city of Texas.

In the 1850's the City of Austin began to grow with the construction of the permanent capitol building and Governor's Mansion, and the arrival of the Houston and Texas Central Railway in 1871. After a fire destroyed the original building, the current Capitol building was completed in 1888, standing taller than the nation's Capital. Soon thereafter the Austin skyline began to take shape with the establishment of the University of Texas in 1883 and the opening of the Driskill Hotel in 1886.<sup>1</sup>

Along with the changing skyline, the population of Austin became more diverse in the early and mid-1900s when large numbers of Germans, Swedes, and Mexicans migrated to the area. Several neighborhood communities began to spring up in the early part of the 19th century, including the community of Clarksville, which was settled by Charles Clark, a freeman, in 1871. The Clarksville area became the heart of the African-American community.<sup>2</sup> The African-American community later migrated east of downtown, and had a significant influence in the development of jazz and blues clubs and Austin's early music scene.<sup>3</sup> Diverse cultural groups have been attracted to Austin throughout its history, including immigrants from Europe, Africa, Mexico, and, most recently, Asia. All of these groups have enriched Austin's civic and cultural life, including its recent development as a draw for music fans.<sup>4</sup>

In 1918, the City of Austin acquired Barton Springs, a group of springs that are counted as the fourth largest spring in Texas. Barton Springs has been attracting attention since the members of various Native American tribes found them to be a reliable and comfortable campsite thousands of years ago. The two major springs were named after Barton's daughters Parthenia and Eliza. Although widely popular as a public swimming hole, campground, and picnic site during the late 1800s, it was 1918 before the springs came under public ownership, when Andrew Zilker donated the land around the springs to the Austin school district, which in turn sold the land to the City of Austin for public park land. Barton Springs remains a popular tourist attraction today.

In 1924, the City of Austin adopted a council-manager government, focusing on City planning and beautification. After the development of the City Plan in 1928, the City of Austin passed a bond that provided for the funding of streets, sewers, libraries, hospitals, and multiple parks. The development of parks, pools and recreational areas, combined with the development of the first municipal airport in 1930, attracted many people to the area. By 1936, the student population for the University of Texas had increased, and the City had funded more municipal projects than any other city in Texas.

The City of Austin has continued to grow, and become known as a leader in the fields of music, film, and technology. The City of Austin has attracted businesses, entrepreneurs, families, musicians, artists, and students worldwide. It is a green and welcoming community, appropriately referred to as the "Live Music Capital of the World" as it is home to over 250 live music venues and festivals. The Austin Marathon draws 20,000 runners from around the world. The Austin Food + Wine Festival welcomes visitors from across the nation and showcase the best innovative cuisine. Fun Fun Fun Fest is known as the nation's best underground punk and alternative music festival;

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<sup>1</sup> Handbook of Texas Online, available at: <http://www.tshaonline.org/handbook/online/articles/hda3.html>

<sup>2</sup> Handbook of Texas Online, available at: <http://www.tshaonline.org/handbook/online/articles/CC/hpc1.html>

<sup>3</sup> AUSTIN HISTORY. (n.d.). Retrieved from <http://www.austintexas.org/visit/things-to-do/history/>

<sup>4</sup> Brief History of Austin. (n.d.). Retrieved from <http://library.austintexas.gov/ahc/brief-history-austin>

## Section 3: Community Profile

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and Fantastic Fest, which features sci-fi, horror, fantasy and other genre films, has become a favorite of film buffs and celebrities alike. SXSW Music, Film and Interactive Conferences and Festivals expand every year and the Austin City Limits Music Festival welcomes over 70,000 fans per day to Zilker Park for performances by more than 100 bands.<sup>5</sup>

New to the City of Austin is the Circuit of the Americas (COTA), attracting over hundreds of thousands of people year round. It is the first purpose-built Grand Prix facility in the United States designed for any and all classes of racing, from motor power to human power, and is the U.S. home to the 2015 FORMULA 1 USGP™ (F1) October 23 – 25.<sup>6</sup> F1 attracted over 265,000 people in 2013 for its inaugural race. Additionally, the COTA master plan features a variety of permanent structures designed for business, education, entertainment and race use; and its signature element is a 3.4 mile circuit track. Other support buildings include an expansive outdoor live music space, which promotes high profile concerts year round; conference center; banquet hall; and state-of-the-art medical facility. Future proposed amenities include a driving and riding experience, a motorsports driving club, kart track, grand plaza event center and tower, and a trackside recreational vehicle park.

The abundant presence of music, art, film, technology and natural resource attractions, brings millions of tourists to the City of Austin area annually.

### **AISD**

As of July 2015, Austin Independent School District (AISD) educates 84,791 students in 129 schools. AISD has 261 National Board Certified Teachers, more than any school district in Texas. AISD's mission is to provide a comprehensive educational experience that is high quality, challenging, and inspiring to all students, making a positive contribution to society.<sup>7</sup>

AISD is governed by a nine-member Board of Trustees who are the district's elected leaders. The trustees employ the superintendent, approve the budget, monitor expenditures, set the tax rate, and may call for a bond or tax rate election.

Almost 75% of the fiscal year 2014 budget comes from the General fund. AISD has the highest bond and State Financial Accountability ratings that school districts can earn in Texas. These ratings reflect AISD's stable financial management and operations, healthy reserves, and manageable debt profile.<sup>8</sup>

## Government

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The City of Austin is "Home Rule" city, meaning that the City Charter operates as the Constitution for the City and allows for the creation of regulations the City of Austin deems necessary unless prohibited by state law. The City Charter for the City of Austin also establishes the community as a council and manager form of government. Previously, the City of Austin featured a city council with a total of seven seats, including the mayor. All were elected at-large and served a maximum of three, three-year terms.

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<sup>5</sup> FESTIVALS IN AUSTIN. (n.d.) Retrieved from <http://www.austintexas.org/visit/things-to-do/festivals/>

<sup>6</sup> United States Grand Prix. (n.d.) Retrieved from <http://www.austinchamber.com/austin/visit/formula-one.php>

<sup>7</sup> About Austin ISD. (2013, October 28). Retrieved from <http://www.austinisd.org/about-us>

<sup>8</sup> Source: <http://www.austinisd.org>

## Section 3: Community Profile

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In November 2012, citizens voted in favor of propositions 1, 2 and 3 to create four new seats; establishing ten districts within the City of Austin, each of which elect its own city council representative and setting council and mayoral term limits to two, four-year staggered terms. The mayor serves on the council as its eleventh member.<sup>[4][5]</sup>

The City Manager is appointed by the city council, and has overall responsibility for the management of all City of Austin employees and the administration of all City affairs.

The City of Austin has over 30 different departments organized under six broad service categories:

- Capital Improvement and Management;
- Development and Environmental Services;
- Community Services;
- Transportation Services;
- Public Safety; and
- Financial and Administrative Support.

The various departments are either financed from an enterprise fund; set up like a business, where customers are charged a fee for services; or through a general fund, financed through taxes and fees.

## Geography

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The City of Austin is located primarily in Travis County, although part of the City of Austin's border extends into Williamson and Hays Counties. The City of Austin is situated on the Colorado River and is located at the eastern edge of the Hill Country and Edwards Plateau, about 236 miles from the Mexican Border. The western portion of the City of Austin is made up of scenic rolling hills and limestone rock, whereas the eastern portion is more flat. Interstate 35 runs through the City of Austin, which occupies a total land area of 301.86 square miles in the Central Texas Hill Country. The City of Austin is approximately 541 feet above sea level and is known for its parks and green space, including greenbelts and lakes. The City of Austin includes three man-made lakes within the City's limits: Lady Bird Lake, Lake Austin, and Lake Walter E. Long. Additionally, the foot of Lake Travis, including Mansfield Dam, is located within the City's limits. The City of Austin contains a mixture of soils from silt clays to fine sandy loams and clay loams over limestone. A popular limestone formation is Mount Bonnell, which overlooks Lake Austin on the Colorado River and is approximately 780 feet above sea level.

The City of Austin is within the Lower Colorado River Basin, which encompasses 21,000 square miles of contributing drainage area, and receives an average of 30 to 40 inches of rain per year. A total of 123 watersheds exist in the City of Austin, of which 13 are located in urban areas and 120 are located in surrounding, non-urban areas. Of these 123 watersheds, 50 are monitored as part of the Environmental Integrity Index (EII), which measures water quality with parameters such as chemical, recreational, aesthetics, and macro-invertebrates scores.<sup>9</sup>

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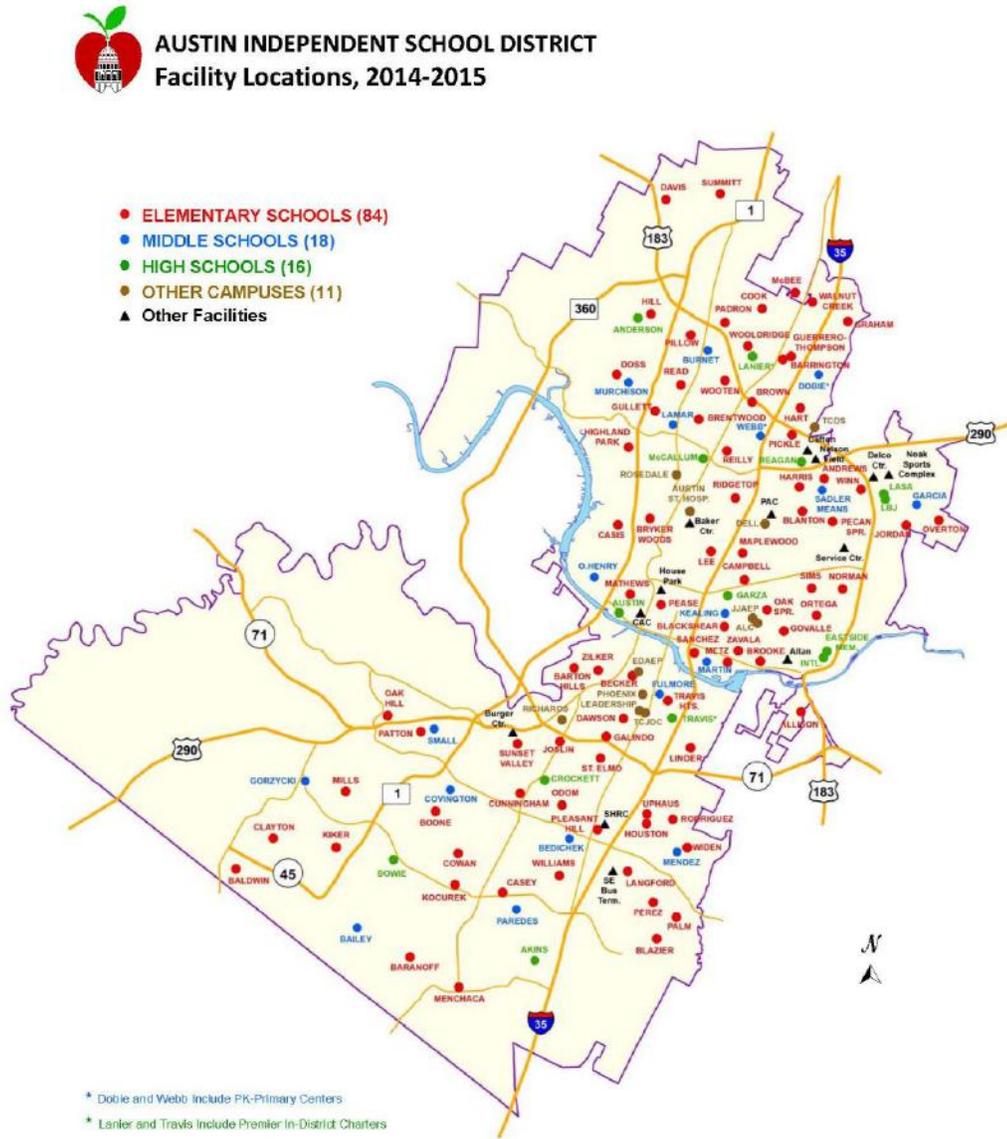
<sup>9</sup> City of Austin Watershed Development

# Section 3: Community Profile

## AISD

AISD is comprised of 129 schools and other facilities. Locations of the schools and facilities are identified in Figure 3-1.

Figure 3-1. Map of AISD Facility Locations<sup>10</sup>



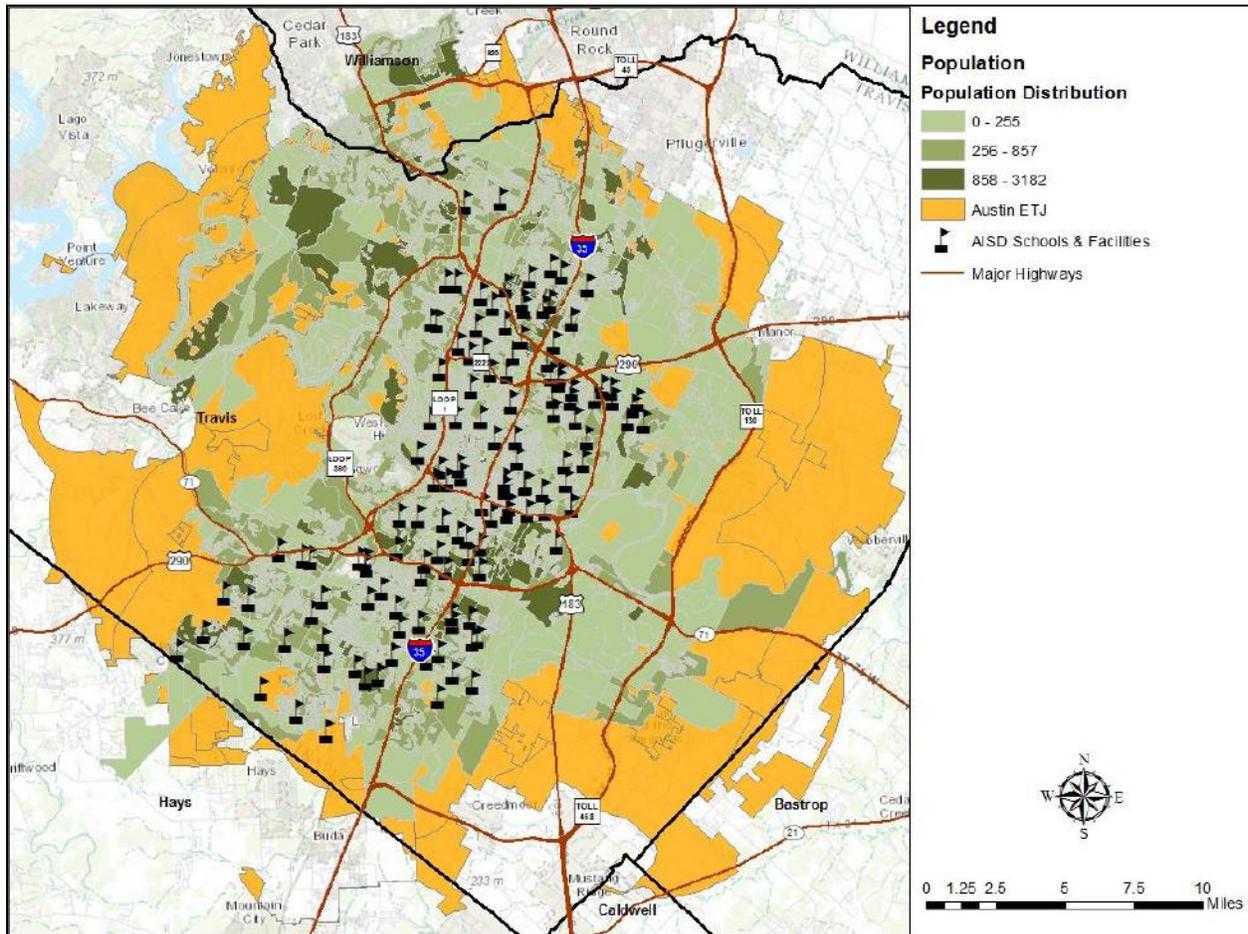
Department of Campus and District Accountability  
08/27/2014

<sup>10</sup> <http://www.austinisd.org>

## Population & Demographics

Figure 3-2 shows the extent of the core planning area (the incorporated limits of the City of Austin) along with the population distribution in this area at the census block level (based on Census 2010 census and parcel level data).

**Figure 3-2. Map of Population Distribution**



A numeric breakdown of the population, including two groups of special needs populations: elderly (persons over the age of 65) and low income (less than \$20,000 annual income) are shown in Table 3-1.

**Table 3-1. Population Distribution/Special Needs Populations**

TOTAL POPULATION (CENSUS 2010)	SPECIAL NEEDS POPULATIONS	
	Elderly (Over 65)	Low Income (< \$20,000)
790,390	55,695	32,564

Austin is one of the top five fastest growing metropolitan areas in the U.S. Population estimates from 1970 to 2010 and population projections from 2020 to 2040 are listed in Table 3-2, and illustrated in Figure 3-2, as provided by the U.S. Census Bureau American Community Survey

## Section 3: Community Profile

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(ACS). Over the past four decades the City of Austin has become increasingly more developed and urbanized (92 percent urban as of 2005). The City of Austin's total population in 1970 was 251,808 and increased by 38 percent to 656,562 by 2000. Between 2000 and 2006, the population increased 7.6 percent. The percent change for the state of Texas between 2000 and 2006 was 12.7 percent. The 2010 population estimate for the City of Austin was 790,390, and 836,800 in 2013, a population increase of 9.2 percent. By 2040, the City of Austin's population is projected to nearly double the 2007 population, for a projected population count of 1,287,510.

**Table 3-2. City of Austin Census Totals, Population Estimates, and Projections**

YEAR	POPULATION
1970 (a)	251,808
1990 (a)	465,622
2000 (a)	656,562
2006 (e)	709,893
2007 (e)	743,074
2010 (e)	790,390
2020 (p)	991,992
2030 (p)	1,151,247
2040 (p)	1,287,510

(a) = actual census data      (e) = population estimate      (p) = population projection

### Age & Sex

According to the ACS, males make up 50.3 percent of the City of Austin's population, a slight majority over females at 49.7 percent. Even though males make up a majority of the population overall, females make up the majority of the population age 65 and older. The median age for the City of Austin's population is 32, with 73 percent of the population over the age of 21.

### Ethnicity

The City of Austin is transforming it into an urban place that hosts various racial groups including Caucasian, Hispanic, African American, and Asian. The Hispanic share of the City of Austin's total population decreased from 35.9 percent in 2008 to 34 percent in 2013, and the Asian share of the total population increased from almost 5.5 percent in 2008 to 6.1 percent in 2013.

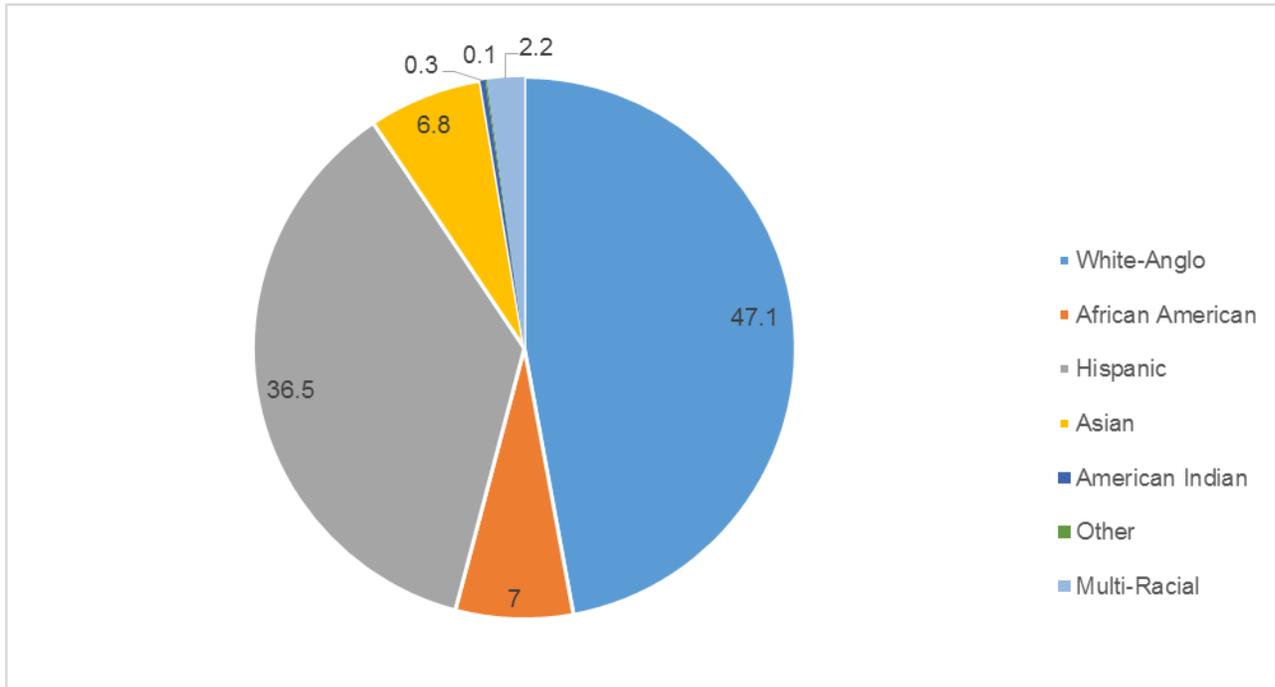
The City of Austin has become a Majority-Minority city, meaning no ethnic or demographic group exists as a majority of the City of Austin's population. The City of Austin's Caucasian share of total population has dropped below 50 percent, and is predicted to remain below 50 percent for the foreseeable due to the growth of other ethnic groups outpacing the growth of Caucasian households.

## Section 3: Community Profile

For example, the growth rate of Latino and Asian households far exceeds the growth of Caucasian households in the City of Austin.<sup>11</sup>

Figure 3-3, below, depicts the ethnicity shares in the City of Austin in 2014 and Table 3-3 displays the percentage of languages spoken at home other than English in the City of Austin, the State of Texas, and the U.S.

**Figure 3-3. City of Austin Race and Ethnicity<sup>12</sup>**



**Table 3-3. Language Spoken at Home Other than English<sup>13</sup>**

Austin MSA	Texas	United States
32.3%	34.7%	20%

### AI SD

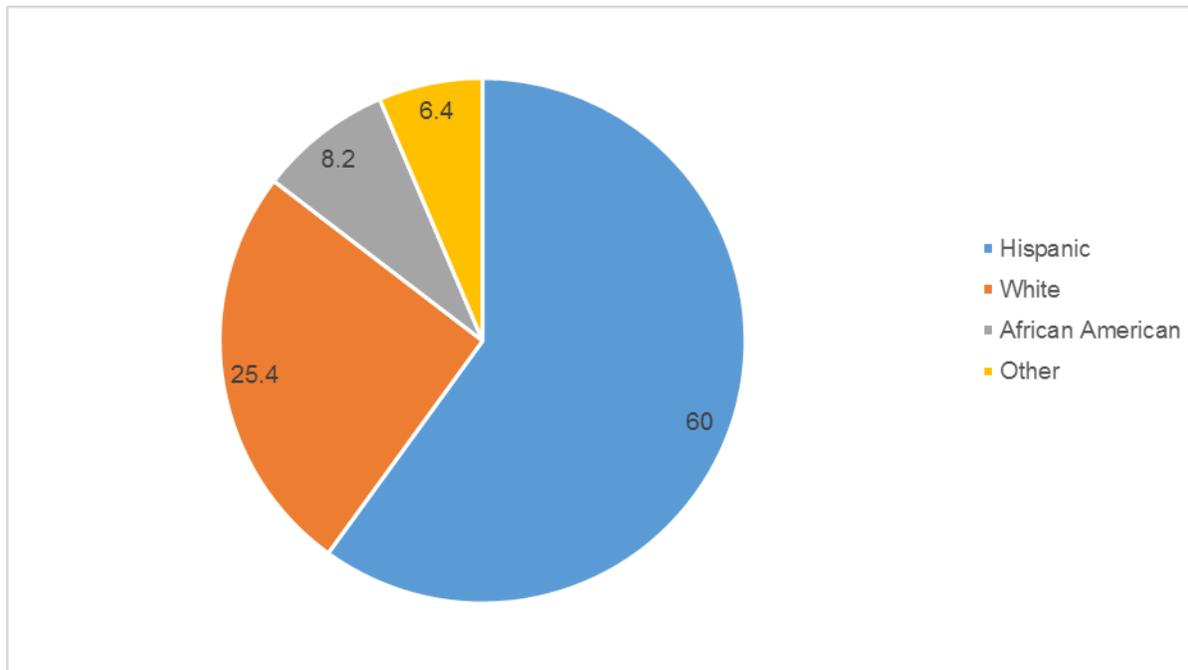
Figure 3-4 identifies the 2013-2014 AISD ethnic proportions.

<sup>11</sup> Top Ten Demographic Trends in Austin, Texas. (n.d.). Retrieved from <http://www.austintexas.gov/page/top-ten-demographic-trends-austin-texas>

<sup>12</sup> (n.d.). Retrieved from [http://www.austintexas.gov/sites/default/files/files/Planning/Demographics/COA\\_Travis\\_MSA\\_2014\\_Race\\_and\\_Ethnicity\\_estimates.pdf](http://www.austintexas.gov/sites/default/files/files/Planning/Demographics/COA_Travis_MSA_2014_Race_and_Ethnicity_estimates.pdf)

<sup>13</sup> Source: U.S. Census Bureau

**Figure 3-4. AISD Ethnicity Breakdown<sup>14</sup>**



**Education**

The American Community Survey (ACS) for 2013 estimates that 86.7 percent of the City of Austin’s, population age 25 and older have earned a high school diploma or higher degree of education. While the U.S. and Texas each have a higher percentage for high school graduates and those with some college or an Associate’s degree among citizens age 25 and older, the City of Austin has a higher percentage of citizen’s that have obtained a Bachelor’s, graduate, or professional degree. Among those residents age 25 and older, 29 percent have a Bachelor’s degree or higher, while 16.6 percent have a graduate or professional degree, which is almost double the overall state percentage.

**Table 3-4. Educational Attainment – Ages 25 and Older**

Educational Level	Austin MSA	Texas	United States
High School Graduate	16.4%	25.3%	28.1%
Some college/Associate’s Degree	24.7%	29%	27.5%
Bachelor’s Degree	29%	17.7%	18%
Graduate/Professional Degree	16.6%	8.9%	10.8%

<sup>14</sup> Source: <http://www.austinisd.org/>

## Section 3: Community Profile

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**Table 3-5. Austin’s Largest Institutions of Higher Education**

University of Texas at Austin
Austin Community College
St. Edward’s University
Concordia University at Austin
ITT Technical Institute
Huston-Tillotson College
Austin Business College
Allied Health Careers
Austin Presbyterian Theological Seminary
Southern Careers Institute
DeVry University
Capital City Trade and Technical School
Episcopal Theological Seminary

### Housing & Household Income

According to estimates by the ACS, there were 366,459 housing units for the City of Austin in 2013. The average household size for the City of Austin is 2.59 people, compared with 2.93 for the state.<sup>15</sup> For family households, the City of Austin also maintains a lower number with 52.7 percent compared to 69.8 percent for Texas. An emerging trend for the City of Austin is the decline in the number of households consisting of families with children.<sup>16</sup> Even though the overall number of families has increased, the total number of households consisting of families with children has decreased.<sup>17</sup> The percentage of families with children has declined from a little over 32 percent in 1970 to just fewer than 26.2 percent in 2013.

Median home values in the City of Austin are the highest in Texas at \$220,500. Statewide, median home values in metropolitan areas are \$128,900, compared to \$176,700 nationally (Table 3-6).

**Table 3-6. Median Value of Owner Occupied Housing, 2013**

Austin MSA	Texas	United States
\$220,500	\$128,900	\$176,700

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<sup>15</sup> U.S. Census Bureau

<sup>16</sup> *Ibid.*

<sup>17</sup> *Ibid.*

## Section 3: Community Profile

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According to a 2013 American Community Survey, the Austin median household income is \$53,946, which is up from \$50,520 in 2010.

**Table 3-7. Median Family Income, 2013**

Austin MSA	Texas	United States
\$53,946	\$51,900	\$53,046

## Economy & Industry

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The City of Austin is a leader in creativity and business, and was designated as the number one place for small businesses to thrive.<sup>18</sup> Additionally, the City of Austin is leading the region's growth (Best City for the Decade – *Kiplinger Finance Magazine*) while maintaining a global competitive advantage.<sup>19</sup> The rate of unemployment is below both state and national rates as shown in Table 3-8.

**Table 3-8. Unemployment Rate – American Community Survey 2013**

Austin MSA	Texas	United States
7.4%	8.1%	9.7%

The City of Austin led the nation's cities in 2013 with a gross metro product growth, the sum of all goods and services produced annually in a city, of 4.6 percent. The City of Austin is expected to rank number one in gross metro product growth through 2020, with an average annual gross metro product growth of 4.4 percent from between 2013 and 2020.<sup>20</sup>

In addition to a growing industry based on high technology and innovation, the City of Austin's biomedical and pharmaceuticals industry is also growing. The University of Texas at Austin provides world-class programs in bioengineering and pharmaceutical research, and is a leader in the number of science and engineering doctoral degrees it awards.

The City of Austin also attracts corporate regional offices and national headquarters. A diverse array of companies also elected to make the City of Austin their headquarters including National Instruments Corp., Whole Foods Market, Inc., and Dell Inc. which is one of the area's largest employers.

The City of Austin strives to serve citizens by influencing and increasing economic development. The City of Austin has established an Economic Growth and Redevelopment Services Office (EGRSO). EGRSO is directed by the Austin City Council and is responsible for implementing economic development policy to increase economic viability.

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<sup>18</sup>WalletHub ranks Austin as Number 1 in nation for "Small Business Vitality" (n.d.). Retrieved from <https://www.austintexas.gov/blog/wallethub-ranks-austin-number-1-nation-small-business-vitality>

<sup>19</sup> Economic Development. (n.d.). Retrieved from <http://austintexas.gov/department/economic-development>

<sup>20</sup> Austin strongest metro economy in nation and will be for years, report finds - Austin Business Journal. (n.d.). Retrieved from <http://www.bizjournals.com/austin/news/2014/06/20/austins-strong-metro-economy-will-stay-ahead-of.html>

## Section 3: Community Profile

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In 2005, the City of Austin developed an economic policy to outline measures adopted by the Austin City Council and evaluate projects based on fiscal impact and the impact on City services. In 2007 the City of Austin evaluated its economic context and forecast, which showed that indicators of job growth, tax revenue and building activity were all positive.

The City of Austin also offers incentive programs such as tax abatements, enterprise zone exemptions, public utility incentives, and financing programs for new and existing companies.

Table 3-9 lists major employers for the City of Austin. Figures 3-5 and 3-6 illustrate major industries for males and females in 2013.

**Table 3-9. Major Employers for the City of Austin<sup>21</sup> (employees of 6,000 or more)**

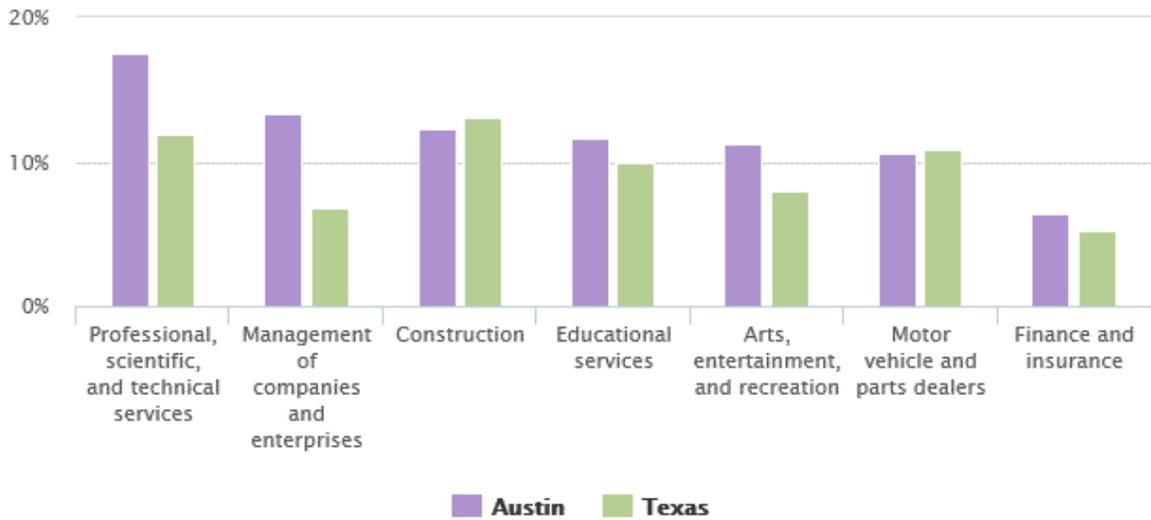
Employer	Business Type
University of Texas at Austin	Higher Education
Dell Computer Corp.	Personal Computer Systems
City of Austin	City Government
Austin Independent School District	Education
St. David's Healthcare Partnership	Healthcare
IBM Corporation	Circuit cards, hardware and software
Seton Healthcare Network	Healthcare
Federal Government	Government
State of Texas	Government

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<sup>21</sup> Austin Chamber of Commerce

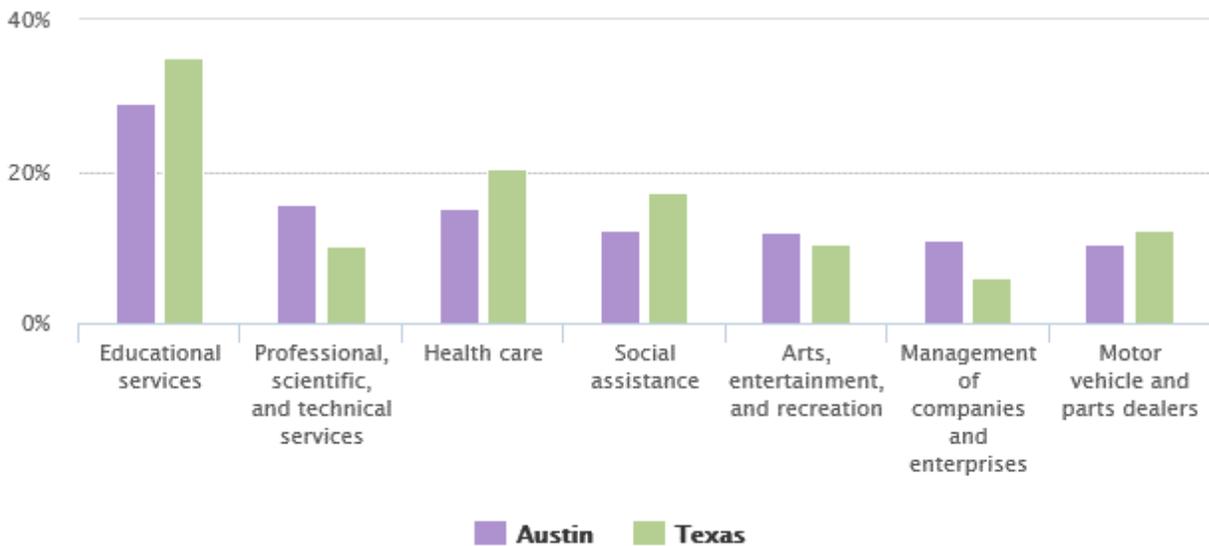
## Section 3: Community Profile

**Figure 3-5. Most Common Industries among Males (Austin/State) - 2013**



As Figure 3-5 illustrates, the most popular industry for males is professional, scientific, and technical services with approximately 17.5 percent, followed by management of companies and enterprises at 13.3 percent. In contrast, the third largest industry for females is healthcare, as shown in Figure 3-6, which did not have a high enough percentage to rank among males.

**Figure 3-6 Most Common Industries among Females (Austin/State) - 2013**



# Section 4: Risk Overview

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## Hazard Identification

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Section 4 is the first phase of the Risk Assessment, providing background information for the hazard identification process, and descriptions for the hazards identified. The Risk Assessment continues with Sections 5 through 21, which include hazard descriptions and vulnerability assessments.

Upon a review of the full range of natural hazards suggested under FEMA planning guidance, the City of Austin, including the Austin Independent School District (AISD), identified ten natural hazards, one technological hazard, and six human-caused hazards that are addressed in the 2016 Hazard Mitigation Plan Update (Plan or Plan Update). Of the hazards identified, eight natural hazards and one quasi-technological hazard (dam failure) were identified as significant, as shown in Table 4-1. The hazards were identified through input from Planning Team members, and a review of the current 2013 State of Texas Hazard Mitigation Plan Update (State Plan Update). Readily available online information from reputable sources such as federal and state agencies were also evaluated and utilized to supplement information as needed.

In general, there are three main categories of hazards including atmospheric, hydrologic, and technological. Atmospheric hazards, are events or incidents associated with weather generated phenomenon. Atmospheric hazards that have been identified as significant for the City of Austin Planning area include extreme heat, extreme wind, tornado, hail, and winter storm (Table 4-1).

Hydrologic hazards, are events or incidents associated with water related damage and account for over 75 percent of Federal disaster declarations in the United States. Hydrologic hazards identified as significant for the planning area include flood and drought.

Technological hazards, refers to the origins of incidents that can arise from human activities, such as the construction and maintenance of dams. Technological hazards are distinct from natural hazards primarily because they originate from human activity. The risks presented by natural hazards may be increased or decreased as a result of human activity, however they are not inherently human-induced. Therefore, dam failure is classified as a quasi-technological hazard, and referred to as “technological,” in Table 4-1 for purposes of description.

For the Risk Assessment, the wildfire hazard is considered “other,” since a wildfire may be natural or human-caused, and is not considered atmospheric or hydrologic.

**Table 4-1. Hazard Descriptions**

HAZARD	DESCRIPTION
<b>ATMOSPHERIC</b>	
<b>Extreme Heat</b>	Extreme heat is the condition whereby temperatures hover ten degrees or more above the average high temperature in a region for an extended period of time.
<b>Hail</b>	Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere and subsequent cooling of the air mass.
<b>Thunderstorm</b>	A thunderstorm occurs when an observer hears thunder. Radar observers use the intensity of the radar echo to distinguish between rain showers and thunderstorms. Lightning detection networks routinely track cloud-to-ground flashes, and therefore thunderstorms.
<b>Tornado</b>	A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. Its vortex rotates cyclonically with wind speeds ranging from as low as 40 mph to as high as 300 mph. The destruction caused by tornadoes ranges from light to catastrophic, depending on the location, intensity, size, and duration of the storm.
<b>Winter Storm</b>	Severe winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Blizzards, the most dangerous of all winter storms, combine low temperatures, heavy snowfall, and winds of at least 35 miles per hour, reducing visibility to only a few yards. Ice storms occur when moisture falls and freezes immediately upon impact on trees, power lines, communication towers, structures, roads, and other hard surfaces. Winter storms and ice storms can down trees, cause widespread power outages, damage property, and cause fatalities and injuries to human life.
<b>Hurricane Wind</b>	A hurricane is an intense tropical weather system of strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 mph or higher.
<b>Expansive Soils</b>	Expansive soils are soils and soft rock that tend to swell or shrink due to changes in moisture content. Changes in soil volume present a hazard primarily to structures built on top of expansive soils.
<b>HYDROLOGIC</b>	
<b>Drought</b>	A prolonged period of less than normal precipitation such that the lack of water causes a serious hydrologic imbalance. Common effects of drought include crop failure, water supply shortages, and fish and wildlife mortality.

## Section 4: Risk Overview

HAZARD	DESCRIPTION
<b>Flood</b>	The accumulation of water within a body of water, which results in the overflow of excess water onto adjacent lands, usually floodplains. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding. Most floods fall into the following three categories: riverine flooding, coastal flooding, and shallow flooding.
<b>OTHER</b>	
<b>Wildfire</b>	A wildfire is an uncontrolled fire burning in an area of vegetative fuels such as grasslands, brush, or woodlands. Heavier fuels with high continuity, steep slopes, high temperatures, low humidity, low rainfall, and high winds all work to increase the risk for people and property located within wildfire hazard areas or along the urban/wildland interface. Wildfires are part of the natural management of forest ecosystems, but most are caused by human factors.
<b>TECHNOLOGICAL</b>	
<b>Dam Failure</b>	Dam failure is the collapse, breach, or other failure of a dam structure resulting in downstream flooding. In the event of a dam failure, the energy of the water stored behind even a small dam is capable of causing loss of life and severe property damage if development exists downstream of the dam.
<b>HUMAN-CAUSED</b>	
<b>Hazardous Materials (Transportation &amp; Fixed-Site)</b>	A hazardous material (solid, liquid, or gaseous contaminants) of flammable or poisonous material that would be a danger to life or to the environment if released without precaution.
<b>Terrorism</b>	Incidents involving the application of one or more modes of harmful force to the built environment. These modes may include contamination (chemical, biological, radiological, or nuclear), energy (explosives, arson, electromagnetic waves), or denial of service (sabotage, infrastructure breakdown, and transportation service disruption). Terrorism is categorized as either domestic or international.
<b>Pipeline Failure</b>	Fuel pipeline breach or pipeline failure addresses the rare, but serious hazard of an oil or natural gas pipeline that, when breached, has the potential to cause extensive property damage and loss of life.
<b>Infectious Disease</b>	A clinically evident disease resulting from the presence of pathogenic microbial agents. These infecting agents may be transmitted through liquids, food, bodily fluids, contaminated objects, airborne inhalation, or through vector-borne dissemination.

HAZARD	DESCRIPTION
<b>Cyber</b>	A cyber-attack is any type of offensive maneuver employed by individuals or whole organizations that targets computer information systems, infrastructures, computer networks, and/or personal computer devices by various means of malicious acts usually originating from an anonymous source that either steals, alters, or destroys a specified target by hacking into a susceptible system.
<b>Technological Disruption</b>	Technological disruptions can be caused by solar flares, geomagnetic storms, and power disruptions. Solar flares are a sudden, rapid, and intense flash of brightness observed over the sun's surface and they occur when magnetic energy that has built up in the solar atmosphere is suddenly released.

### Natural Hazards and Climate Change

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Climate change is defined as a long-term hazard which can increase or decrease the risk of other weather hazards; and directly endangers property due to sea level rise, and biological organisms due to habitat destruction.

Global climate change is expected to exacerbate the risks of certain types of natural hazards impacted through rising sea levels, warmer ocean temperatures, higher humidity, the possibility of stronger storms and an increase in wind and flood damages due to storm surges. While sea level rise is a natural phenomenon and has been occurring for several thousand years, the general scientific consensus is that the rate has increased in the past 200 years, from .5 millimeters per year to 2 millimeters per year.

Texas is considered one of the more vulnerable states in the U.S. to both abrupt climate changes and to the impact of gradual climate changes to the natural and built environments. In Central Texas, the Colorado River Basin is experiencing an unprecedented drought that could continue to strain water resources for years to come. Inflow of total water volume to Lakes Travis and Buchanan is a key measure of the drought's intensity. Inflow of total water volume to these lakes has been dramatically low, with the top five lowest annual inflows occurring since 2006. Another key measure of the drought's intensity and duration is the combined storage volume in Lakes Travis and Buchanan, which dropped to 35 percent capacity in February 2015. In 2014, the combined storage dropped alarmingly close to the all-time minimum. Additional climate impacts which have required tens of millions of dollars to address recovery efforts locally include:

- The summer of 2011, the City of Austin had 90 days with temperatures of at least 100 degrees Fahrenheit.
- Multiple wildfires destroyed over 1,500 homes and 32,000 acres of forest surrounding the nearby City of Bastrop in 2011.
- The Halloween flood of 2013 resulted in loss of life, caused extensive damage to homes and businesses around Onion Creek, and displaced many people from their homes. In addition, the loss of vegetation from intense precipitation combined with prolonged drought conditions may increase flooding severity in the future.

## Section 4: Risk Overview

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Mega-droughts can trigger abrupt changes to regional ecosystems and the water cycle, drastically increase extreme summer temperature and fire risk, and reduce availability of water resources, as Texas experienced during 2011-2012.

Paleoclimate records also show that the climate over Texas had large changes between periods of frequent mega-droughts and the periods of mild droughts that Texas is currently experiencing. While the cause of these fluctuations is unclear, it would be wise to anticipate that such changes could occur again, and may even be occurring now.

Climate change in Texas is consistent with larger-scale trends observed across the U.S. and the world. Based on the data collected at the Camp Mabry weather station in the City of Austin, projected climate changes include:

- Increases in annual and seasonal average temperatures,
- more frequent high temperature extremes,
- little change in annual average precipitation,
- more frequent extreme precipitation,
- slight increase in the number of dry days per year, and
- more frequent drought conditions in summer due to hotter weather.<sup>1</sup>

The State of Texas will leverage state-of-the-art technologies such as remote sensing and crowd-sourcing and high-resolution digital elevation and climate modeling databases, resulting in a scalable platform that not only disseminates information to the public but allows user-uploaded data to help populate key databases on building and community exposure. Once developed, the system will provide short- and long-term risk information to governments at all levels for prioritizing hazard mitigation and climate adaptation policies, as well as to individual homeowners and business owners for self-motivated activities. This system will directly support the objectives of National Oceanic Atmospheric Administration (NOAA) Next Generation Strategic Plan of developing an integrated environment modeling system and fostering partnerships for climate adaptation and mitigation. Furthermore, it will advance our capability to assess risk, prepare for, and respond to the impacts of climate change, which is the focus of FY13 COCA competition.

The key components of the proposed web-based system consist of:

- Regional maps showing the magnitude of coastal hazards (i.e., flooding, hurricanes, storm surge) based on benchmarks and future projections, including both local subsidence and climate change;
- Exposure databases describing the density of urban development along the coast by land use type;
- Region-specific vulnerability models for buildings and critical infrastructure;
- Risk indices quantifying relative levels of impact or damage by hazard;
- Community awareness programs guiding local communities on risk management;
- User-friendly interface enabling the public to contribute to the improvement of exposure database; and
- Real-time and/or simulated feeds of current and future disasters for rapid impact assessment.

The initial focus for database and platform development will be on Texas and Louisiana; however, transferability will be a key consideration when designing the framework, and a long-term

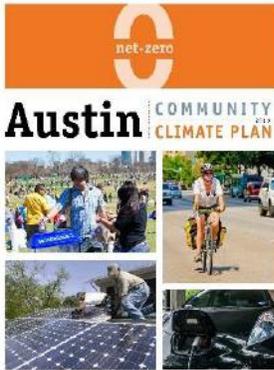
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<sup>1</sup> [http://austintexas.gov/sites/default/files/files/Sustainability/Climate/Toward\\_a\\_Climate\\_Resilient\\_Austin.pdf](http://austintexas.gov/sites/default/files/files/Sustainability/Climate/Toward_a_Climate_Resilient_Austin.pdf)

## Section 4: Risk Overview

implementation plan for other states along the Atlantic and Gulf Coasts will be prepared as part of this project. Project partners sought for this study will include NOAA labs, Department of Homeland Security (DHS), FEMA, National Aeronautics and Space Administration (NASA), local and state governments, universities, and disaster relief organizations.

### Austin Community Climate Plan



On April 10, 2014, the Austin City Council passed Resolution 20140410-024 that established a new long-term goal of reaching net zero community-wide greenhouse gas emissions by 2050, or earlier if feasible. The Office of Sustainability initiated efforts to develop energy, transportation, waste, and industrial sector actions plans to meet this goal, which included collaboration with community experts, City departments, and input from the general public.

On June 4, 2015, the Austin City Council passed Resolution 20150604-048, adopting the City of Austin's Community Climate Plan that gives additional direction on next steps. The actions identified in the plan will result in both immediate and cumulative reductions in emissions resulting from electricity and natural gas production, transportation, materials management, and industrial process sources.<sup>2</sup>



2015 Austin Community Climate Plan

<sup>2</sup> Austin Community Climate Plan. (n.d.). Retrieved from <https://austintexas.gov/page/community-greenhouse-gas-emissions>

## Overview of Hazard Analysis

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The methodologies utilized to develop the Risk Assessment are FEMA’s loss estimation software, Hazards United States Multi-Hazards (HAZUS-MH), and a statistical approach. Both methodologies provide an estimate of potential impact by using a common, systematic framework for evaluation.

HAZUS-MH is FEMA’s standardized loss estimation software program built upon an integrated geographic information system (GIS) platform. HAZUS-MH was utilized in the Risk Assessment to develop regional profiles and estimate losses due to damage caused by a flood event for the 2016 Hazard Mitigation Plan Update.

The HAZUS-MH software and resulting Risk Assessment methodology are parametric, and distinct hazard and inventory parameters (e.g., wind speed and building types) are modeled to determine the impact (e.g., damages and losses) on the built environment.

Records retrieved from National Climatic Data Center (NCDC) and Spatial Hazard Events & Losses Database for the United States (SHELDUS) were reported for the City of Austin planning area including the AISD. Remaining records identifying the occurrence of hazard events in the planning area and the maximum recorded magnitude of each event were also evaluated.

The four general parameters that are described for each hazard in the Risk Assessment include frequency of return, approximate annualized losses, a description of general vulnerability, and a statement of the hazard’s impact.

Frequency of return was calculated by dividing the number of events in the recorded time period for each hazard by the overall time period that the resource database was recording events. Frequency of return statements are defined in Table 4-2, and impact statements are defined in Table 4-3 below.

**Table 4-2. Frequency of Return Statements**

PROBABILITY	DESCRIPTION
<b>Highly Likely</b>	Event is probable in the next year.
<b>Likely</b>	Event is probable in the next three years.
<b>Occasional</b>	Event is probable in the next five years.
<b>Unlikely</b>	Event is probable in the next ten years.

**Table 4-3. Impact Statements**

POTENTIAL SEVERITY	DESCRIPTION
<b>Substantial</b>	Multiple deaths. Complete shutdown of facilities for 30 days or more. More than 50 percent of property destroyed or with major damage.
<b>Major</b>	Injuries and illnesses resulting in permanent disability. Complete shutdown of critical facilities for at least two weeks. More than 25 percent of property destroyed or with major damage.

## Section 4: Risk Overview

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POTENTIAL SEVERITY	DESCRIPTION
<b>Minor</b>	Injuries and illnesses do not result in permanent disability. Complete shutdown of critical facilities for more than one week. More than 10 percent of property destroyed or with major damage.
<b>Limited</b>	Injuries and illnesses are treatable with first aid. Shutdown of critical facilities and services for 24 hours or less. Less than 10 percent of property destroyed or with major damage.

Each of the hazard profiles includes a description of a general Vulnerability Assessment. Vulnerability is the total of assets that are subject to damages from a hazard, based on historic recorded damages. Assets in the region were inventoried and defined in hazard zones where appropriate. The total amount of damages, including property and crop damages, for each hazard is divided by the total number of assets (building value totals) in that community to determine the percentage of damage that each hazard can cause to the community.

To better understand how future growth and development in the City of Austin might affect hazard vulnerability, it is useful to consider population growth, occupied and vacant land, the potential for future development in hazard areas, and current planning and growth management efforts. Hazard vulnerability for the City of Austin was reviewed based on recent changes in development that occurred throughout the planning area. The City of Austin grew over 15% between 2010 and 2014 according to the U.S. Census Bureau, therefore the vulnerability to the population, infrastructure, and buildings has increased for hazards that do not have a geographical boundary. The City of Austin follows the International Building Code and both the City and National Flood Insurance Program regulations apply for building in the 25 year and 100 year floodplains. Encroachment of buildings and parking areas is prohibited in the 25-year floodplain and restricted in the 100-year floodplain in order to protect citizens and their property. Therefore vulnerability has not increased for flood.

Building permits indicate what types of buildings are being constructed and their relative uses. Table 4-4 lists the number of residential building permits for the City of Austin that have been granted between 2011 and 2015. The data includes all sizes of family homes for reported permits, as well as the construction costs, to show the potential increase in vulnerability of structures to various hazards reviewed in the risk assessment. The increase in vulnerability can be attributed to the higher construction costs that would be factored into repairing or replacing a structure using current market values.

**Table 4-4. Residential Building Permits<sup>3</sup>**

CITY OF AUSTIN			
YEAR	BUILDINGS	UNITS	CONSTRUCTION COSTS
2015	3,192	10,092	\$1,372,412,203
2014	3,136	9,442	\$1,105,477,365
2013	3,025	11,834	\$1,255,616,970
2012	2,710	10,210	\$985,084,766
2011	1,807	4,178	\$415,619,034

The AISD's student population has slightly decreased over the last 5 years, although the Northwest Region and portions of the Southeast Region experienced increases; there has been no significant factors or development trends with a consequential effect or increase in overall risk and vulnerability to natural hazards.

Once loss estimates and hazard vulnerability were determined for the planning area, an impact statement was developed. The impact statement describes the potential impact of the hazard to the assets within the planning area.

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<sup>3</sup> <http://censtats.census.gov/cgi-bin/bldgprmt/bldgdisp.pl>

# Section 5: Flood

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## Hazard Description

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Floods generally result from excessive precipitation, and the severity of a flooding event is typically determined by a combination of several major factors, including stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface. Generally, floods are long-term events that may last for several days.

The primary types of general flooding are inland and coastal flooding. Due to the City of Austin’s inland location, only inland flooding is profiled in Section 5. Inland or riverine flooding is a function of excessive precipitation levels and water runoff volumes within the watershed of a stream or river. It is natural and inevitable as it is the overbank flooding of rivers and streams, typically resulting from large-scale weather systems that generate prolonged rainfall over a wide geographic area. Some river floods occur seasonally when winter or spring rainfalls fill river basins with too much water, too quickly. Torrential rains from decaying hurricanes or tropical systems can also produce river flooding.

## Location

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Locations of flood zones in the City of Austin based on the digital Flood Insurance Rate Map (DFIRM) from FEMA are illustrated in Figures 5-1 and 5-2.

# Section 5: Flood

Figure 5-1. Estimated Flood Zones in the City of Austin and ETJ

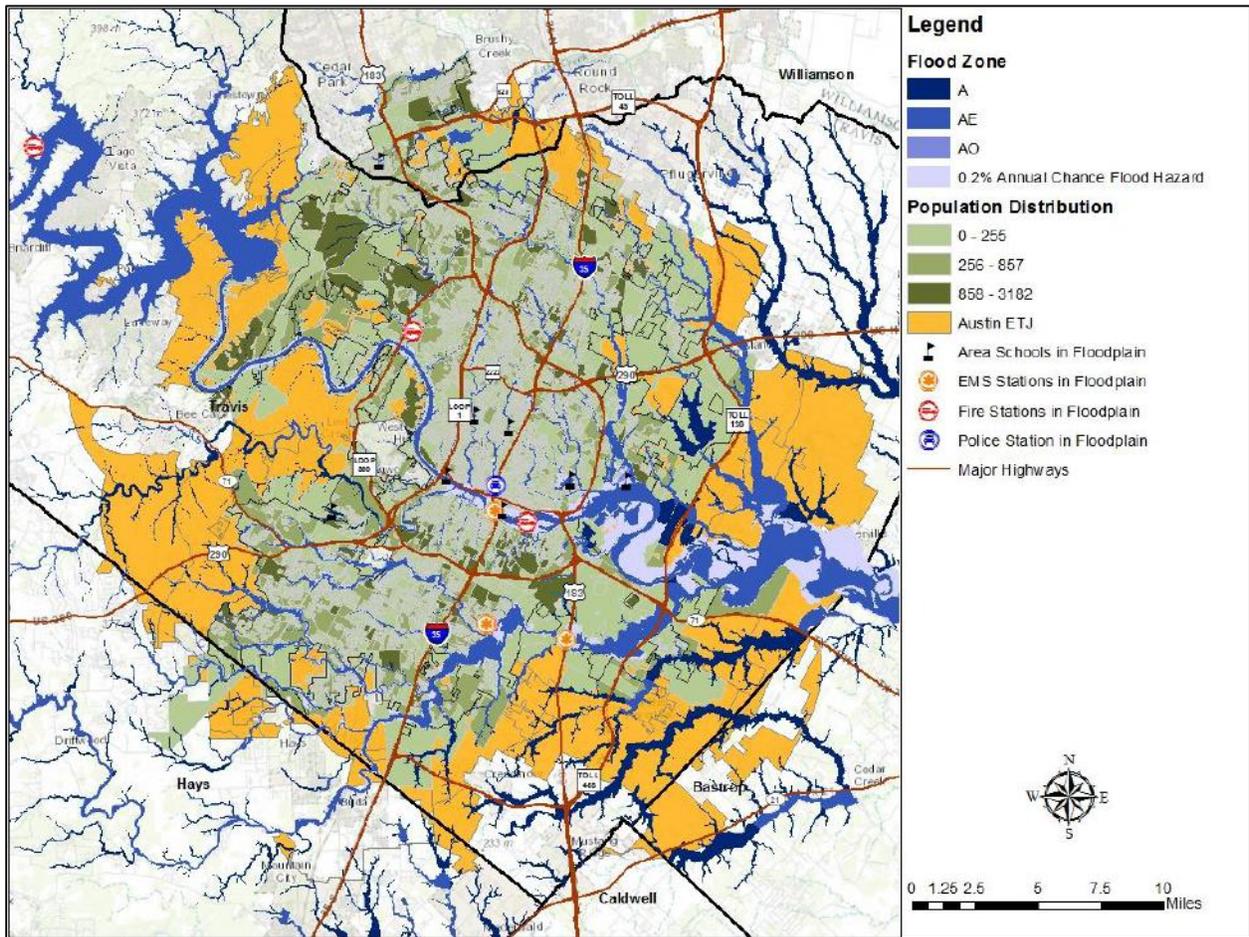
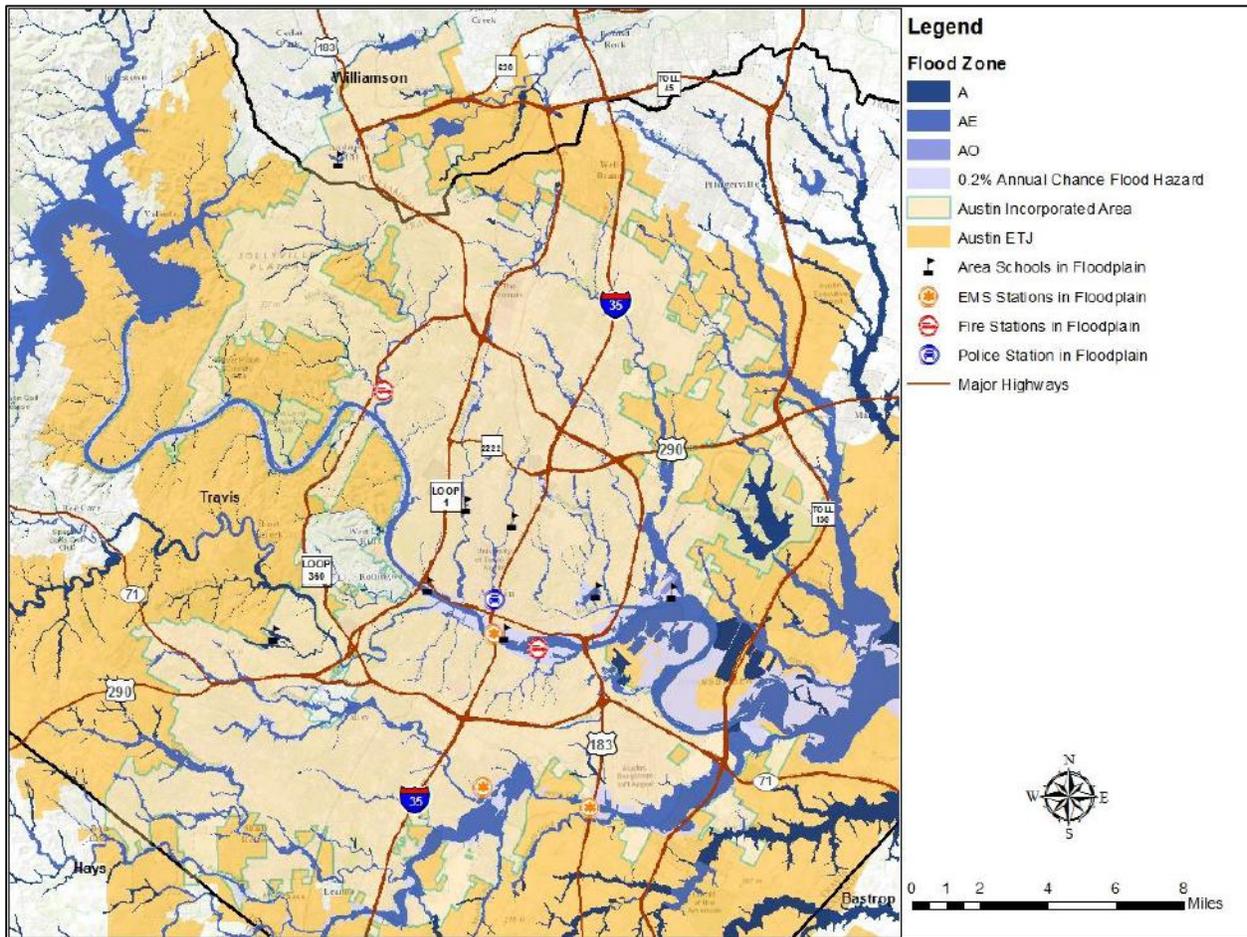


Figure 5-2. Estimated Flood Zones in the City of Austin



## Extent

The severity of a flood event is typically determined by a combination of several factors including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and degree of vegetative clearing and impervious surface. Generally, floods are long-term events that may last for several days.

Determining the intensity and magnitude of a flood event is dependent upon the flood zone and location of the flood hazard area in addition to depths of flood waters. FEMA categorizes areas on the terrain according to how the area will convey the discharge of flood water. The extent of flood damages can be expected to be more damaging in the areas where a base flood can occur. A base flood is defined by FEMA as a flood having a one percent chance of being equaled or exceeded in any given year. This is the regulatory standard also referred to as the "100-year flood." The base flood is the national standard used by the National Flood Insurance Program (NFIP) and all Federal agencies for

## Section 5: Flood

the purposes of requiring the purchase of flood insurance and regulating new development.<sup>1</sup> Flood zones are the categories that are mapped on Flood Insurance Rate Maps. Table 5-1 provides a description of FEMA flood zones and the flood impact in terms of severity or potential harm. Flood Zone A, AE and AO are the only hazard areas mapped in the planning area. Figures 5-1 and 5-2 should be read in conjunction with the extent for flooding in Tables 5-1, 5-2, and 5-3 to determine the intensity of a potential flooding event.

**Table 5-1. Flood Zones**

INTENSITY	ZONE	DESCRIPTION
HIGH	ZONE A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
	ZONE A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a Base Flood Elevation (BFE) (old format).
	ZONE AE	The base floodplain where base flood elevations are provided. AE Zones are now used on the new format FIRMs instead of A1-A30 Zones.
	ZONE AO	River or stream flood hazard areas and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
	ZONE AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
	ZONE A99	Areas with a 1% annual chance of flooding that will be protected by a federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

<sup>1</sup> Base Flood. (n.d.). Retrieved from <http://www.fema.gov/base-flood>

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INTENSITY	ZONE	DESCRIPTION
	<b>ZONE AR</b>	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
<b>MODERATE to LOW</b>	<b>ZONE X 500</b>	An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from 100-year flooding.

Zone A is interchangeably referred to as the 100-year flood, the one-percent-annual chance flood, or the Special Flood Hazard Area (SFHA), or more commonly, the base flood. Zone A is the area where the base flood will occur, and therefore constitutes a threat to the planning area.

Structures built in the Special Flood Hazard Area are subject to damage by rising waters and floating debris. Moving flood water exerts pressure on everything in its path and causes erosion of soil and solid objects. Utility systems, such as heating, ventilation, air conditioning, fuel, electrical systems, sewage maintenance systems and water systems, if not elevated above base flood elevation, may also be damaged.

In addition to the flood zones, extent is provided in terms of depth of flood waters. The elevation varies for the City of Austin between 400 and 1,080 feet above sea level. Table 5-2 below describes the category of risk and potential magnitude of an event. The water depths depicted in Table 5-2 are an approximation based on elevation data. Table 5-3 reflects extent associated with stream gage data provided by the United States Geological Survey (USGS).

**Table 5-2. Extent Scale – Water Depth**

SEVERITY	DEPTH (in feet)	DESCRIPTION
<b>BELOW FLOOD STAGE</b>	0 to 15	Water begins to exceed low sections of banks and the lowest sections of the floodplain.
<b>ACTION STAGE</b>	16 to 23	Flow is well into the floodplain, minor lowland flooding reaches low areas of the floodplain. Livestock should be moved from low lying areas.
<b>FLOOD STAGE</b>	24 to 28	Homes are threatened and properties downstream of river flows or in low lying areas begin to flood.

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SEVERITY	DEPTH (in feet)	DESCRIPTION
<b>MODERATE FLOOD STAGE</b>	29 to 32	At this stage the lowest homes downstream flood. Roads and bridges in the floodplain flood severely and are dangerous to motorists.
<b>MAJOR FLOOD STAGE</b>	33 and above	Major flooding approaches homes in the floodplain. Primary and secondary roads and bridges are severely flooded and very dangerous. Major flooding extends well into the floodplain, destroying property, equipment and livestock.

**Table 5-3. Extent for the City of Austin**

JURISDICTION	ESTIMATED SEVERITY PER FLOOD EVENT <sup>2</sup>	PEAK FLOOD EVENT
City of Austin	Below Flood Stage, 0 to 15 feet	Major Action Stage: Colorado River in Austin had floodwaters reach 273 feet in December 1913 and 46 feet in July 1869.

The range of intensity that the City of Austin can experience is high, or Zone A. Based on reporting from the USGS peak streamflow data, the average flood event places the City of Austin at the extent of “Below Flood Stage” as shown in Tables 5-2 and 5-3. However, the City of Austin has experienced a “Major Flood Stage” with flooding over 33 feet. Based on historical occurrences, the planning area could expect to experience anywhere from 2.5 inches up to 14 inches of water within a 4 hour window due to flooding.

Reading Tables 5-1 through 5-3 together with Figures 5-1 and 5-2 and historical occurrences for the planning area, provides estimated and potential flood event magnitude and severity for the City of Austin. The City of Austin may experience a range of flooding events from below 15 feet upwards to above 33 feet or from “Below Flood Stage” to almost a “Major Flood Stage.”

## Historical Occurrences

Historical evidence shows that areas within the City of Austin are susceptible to flooding, especially in the form of flash flooding. Only flood events that have been reported have been factored into this Risk Assessment. It is likely that additional flood occurrences have gone unreported before and during this recording period. Table 5-4 shows historical incident information for the City of Austin which resulted in property or crop damage.

Historical data is provided by the Storm Prediction Center (NOAA) and NCEP databases for the City of Austin from January 1996 to November 2014.

<sup>2</sup> Severity estimated by averaging floods at certain stage level over the history of flood events.

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**Table 5-4. Historical Flood Events, 1996-2014<sup>3</sup>**

DATE	TIME	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
8/24/1996	11:30 a.m.	0	0	\$44,880	\$0
8/24/1996	10:30 a.m.	0	0	\$14,960	\$0
5/27/1997	4:00 p.m.	1	0	\$7,312	\$0
6/17/1997	4:30 a.m.	0	0	\$14,624	\$0
7/30/1997	6:00 p.m.	0	0	\$73,122	\$0
10/17/1998	10:00 a.m.	0	50	\$1,440,012	\$72,001
8/31/2001	9:00 p.m.	0	0	\$26,507	\$0
7/2/2002	3:33 p.m.	1	0	\$0	\$0
6/3/2007	8:50 p.m.	0	0	\$56,603	\$0
7/6/2007	7:00 p.m.	1	0	\$0	\$0
6/11/2009	9:00 p.m.	0	0	\$2,188,173	\$0
9/7/2010	11:00 p.m.	1	0	\$0	\$0
10/31/2013	2:00 a.m.	4	0	\$100,757,651	\$0
11/22/2013	11:30 a.m.	1	0	\$0	\$0
9/18/2014	1:00 a.m.	1	0	\$0	\$0

**Table 5-5. Summary of Historical Flood Events, 1996-2014**

EVENTS	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
<b>76 events</b>	<b>10</b>	<b>50</b>	<b>\$104,623,845</b>	<b>\$72,001</b>

Based on the list of historical flood events for the City of Austin (listed above), 33 of the events occurred after the 2010 Plan Update. Below is a list of events that the AISD have on record for the period from the 2010 Plan Update through 2014. It is important to note that AISD includes schools and facilities within the City of Austin planning area. There may be some occurrences that have occurred for the

<sup>3</sup> Only recorded events with fatalities, injuries, or damages are listed.

## Section 5: Flood

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AISSD and may not have been recorded, but are included in the City of Austin occurrence data because of their location.

**Table 5-6. Summary of Flood Events for AISSD, 2010-2014**

DATE	EVENT	SCHOOLS AFFECTED
10/31/2013	Flash Flood (Onion Creek Flood)	Perez, Mendez, Blazier, Widen, Palm
11/22/2014	Flood	Anderson

### Significant Events

#### Flash Flood on October 31, 2013 – City of Austin

Prolonged flow from the Gulf of Mexico produced a deep moist layer at the surface with perceptible water values at two standard deviations above the mean on area surroundings. An upper level trough of low pressure moved out of northern New Mexico and across the Texas Panhandle providing lift to produce showers and thunderstorms. A surface trough was the focus of training storms which produced heavy rainfall that led to major flooding across the Onion Creek and Blanco/San Marcos River watersheds.

Heavy rains in excess of 14 inches upstream of the City of Austin in the Onion Creek Watershed near Wimberly caused a flash flood that hit portions of South Austin in the early morning hours. Water started to rise and flood portions of the Onion Creek area near Interstate 35 by 4-5 a.m. on the morning of October 31, 2013, and water continued to rise into the early morning hours. USGS gauges were overtopped near Twin Creek Road and this record flood water continued to move along Onion Creek, passing under I-35 and inundating several neighborhoods between I-35 and US Highway 183.

Flood waters rose so quickly that most residents sheltered in place and were rescued by truck and helicopter later that morning. Those that tried to escape the flood waters via their vehicles got caught in the rising waters and this led to several fatalities. A mother and infant son died when their SUV vehicle was swept off the Onion Creek Bridge on Bluff Springs Road in the predawn hours around 4:30 a.m. Another resident in a neighborhood along Onion Creek was also found drowned as his vehicle got swept off the road and was recovered near Pleasant Valley Drive and William Cannon. Almost 2 weeks later the body of a homeless man was found in Williamson Creek near South First Street and Heartwood. He was presumed a flood fatality from this event. Manual readings were performed by USGS at the Onion Creek/Highway 183 gauge site ATIT2. Onion Creek crested just over 40 feet at 9:30 a.m. on the morning of October 31, 2013. This was a new record height for this location and translated to about 135,000 cubic feet per second. Across Travis County and the City of Austin over 700 homes were damaged by flooding, of which over 100 were destroyed. Most of the affected homes did not have insurance and were within the 100 year floodplain of Onion Creek. Flood recovery efforts lasted for several weeks including debris removal. Damage estimates were still being calculated when reported, but damages across Travis County and City of Austin were estimated to exceed \$100 million.

#### Flash Flood on June 11, 2009 – City of Austin

A mesoscale convective system developed along a dryline in Central Texas and moved southeastward through the northwestern part of South Central Texas. Thunderstorms within this system produced

## Section 5: Flood

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severe winds and large hail. The bridge at 12<sup>th</sup> Street and Red River Street in the City of Austin was washed out. The flash flood caused \$2 million in damages.

### **Flash Flood and Flood on October 17, 1998 – City of Austin**

Shoal Creek at West 12th Street in the City of Austin crested at 15.4 feet. Several businesses downstream flooded up to two feet, and nearly a foot of water flooded over Shoal Creek Boulevard just above West 12th Street. Flood water discharge reached the Lamar Street Bridge, and was close to flooding many businesses near West 6th Street. Williamson Creek at Oak Hill on Highway 290 West, crested at 6.8 feet at 11 a.m. on October 17<sup>th</sup>, flooding businesses in the shopping mall. Onion Creek crested at 24.9 feet, with flood stage at 7 feet. This produced 19 feet of flood water discharge over the FM 150 bridge near Driftwood and put two feet of water into several mobile homes. The William Cannon Drive bridge floor had near 20 feet of flood water discharge over it. At Highway 183, Onion Creek crested at 32.0 feet, where flood stage is 20 feet. Walnut Creek crested just above 25 feet, causing minor flooding.

## Probability of Future Events

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Based on recorded historical occurrences and extent, a flood event is highly likely for the City of Austin and AISD, meaning an event will occur within the next year.

## Vulnerability and Impact

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Flooding is the deadliest natural disaster that occurs in the U.S. each year, and Texas leads the nation most every year in flood-related deaths and damages. The Austin planning area is a populated area with great runoff potential and is located in one of the most flash-flood prone regions in North America; therefore, flooding poses a constant and significant threat to the health and safety of the people in the Austin planning area. According to FEMA and the NWS, the majority of deaths attributed to flooding occur in vehicles, as people attempt to drive through moving water; Austin is no exception to this statistic.

Flood-related rescues often occur at swift water and low water crossings. Swift water rescues are rare, since most calls for assistance are related to stalled or stranded vehicles in or near low water crossings. Increased development or changes to the hydrology and floodplain of an area may result in new low water crossings.

Flooding can also pose health risks and threats to people while an area is flooded and after the flood waters have receded. Standing water can hide chemicals that can cause health issues. Untreated sewage and hazardous chemicals may be present in floodwater, and can pool in flooded buildings, homes, and automobiles. After the flood waters recede, these toxins may also be present as a layer of residue over property. Water and food sources may be contaminated by flood waters and the pollutants they bring. Mold spores will grow in wet, organic materials, such as bedding, clothing, or wall insulation, causing health respiratory issues and potential structural damage to buildings. Electric power is often interrupted temporarily, and downed power lines and other electrical wires pose a threat of electrocution. While some flooding situations may cause little more than a clean-up effort and a short-term utility interruption, even those situations will have an impact on the overall quality of life for people, and can present a long-term safety threat if left unresolved or untreated.

Other impacts include the potential need to evacuate a location because of rising floodwaters and the potential for displacement from residences because of flood damage. Road closures may occur,

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causing other routes to be used for evacuations, and potentially obstructing access to flooded areas and preventing first responders from responding to calls for assistance.

Response personnel are exposed to greater risks and impacts than the general public in a flood event because of their roles. They are responsible for performing high and swift water rescues when flooding occurs. Not only are these rescues dangerous, the responders may encounter hazards in floodwaters including submerged or water-borne debris and hazardous materials.

It is imperative that both public and private entities plan for flooding events and address how they will be able to function and provide services until normal operating conditions can be resumed. Private sector entities on which the City of Austin and its planning area residents rely, such as utility providers, financial institutions, and medical care providers should have specific plans that are routinely exercised. For example, if flooding resulted in the closure of roadways over a large area, this would result in a temporary halt to repair of damaged infrastructure, delayed emergency response activities, and interruption in the normal delivery of goods and services. Flooded electrical substations, downed power lines, contaminated wells, broken pipelines are common occurrences during flood events, and would impact the area's normal operations and service delivery.

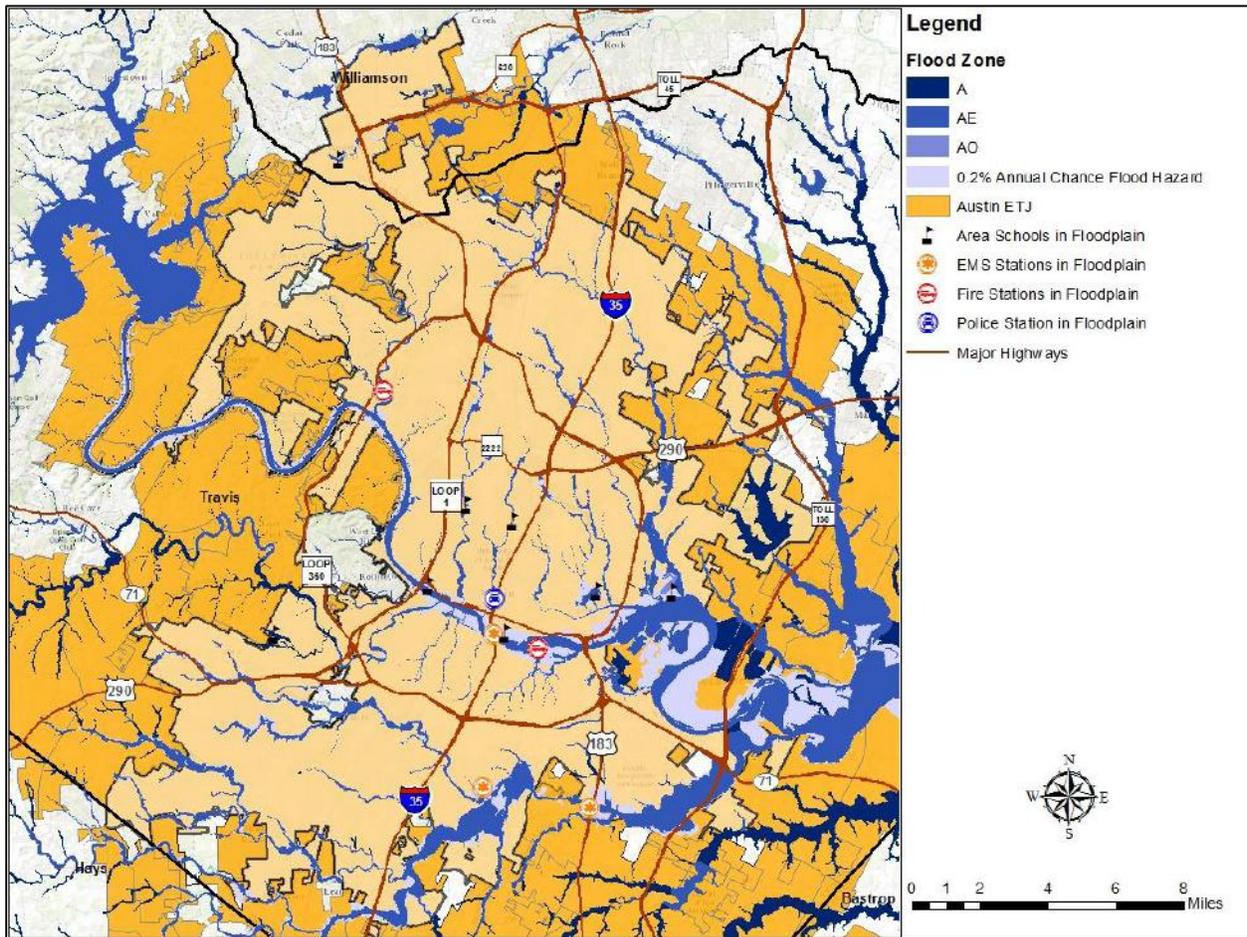
The Austin Independent School District is also at risk from damages from floods. Damages to the district's buildings or power outages could make the schools unsafe for students to attend. The AISD schools and facilities that are vulnerable to flooding can be found in Figure 5-4 below.

A property's vulnerability to a flood depends on its location in, or in proximity, to the floodplain. Structures that lie along banks of a waterway are the most vulnerable and are often repetitive loss structures.

The City of Austin planning area has experienced high growth (36% growth since 2000, according to the U.S. Census), resulting in greater flood losses due to extensive development in this area. However, due to the generally flat terrain of this Central Texas County, homes and businesses in the floodplain remain at risk of flash flooding. During periods of heavy rainfall, homes and businesses located in some areas of the City experience rapid runoff and are vulnerable to flooding from the many major and minor waterways.

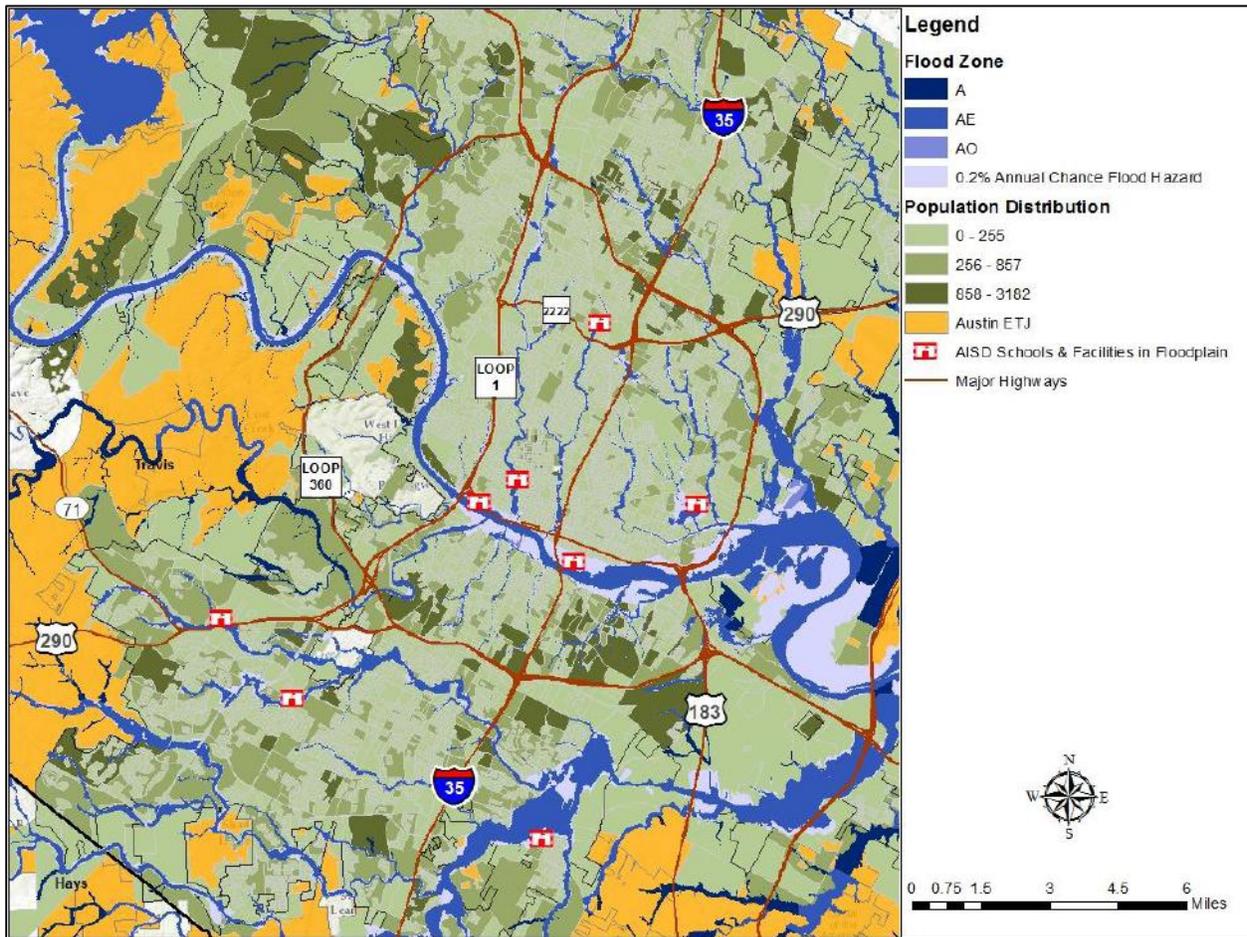
Although the City has encouraged development outside of the floodplain, impact for flood for the City of Austin planning area is "Substantial" as it could result in the shutdown of facilities for 30 days, depending on the scale of the storm.

Figure 5-3. Critical Facilities Vulnerable to Flooding



The City of Austin critical facilities located in the floodplain include: Travis County State Jail, Noel Grisham Middle, The Griffin School, Regents School of Austin, Ace Academy, Fire station/EMS Station #24, EMS Station #28, EMS Headquarters, Fire Station #31, Austin Fire Department Wellness, and Police Headquarters.

Figure 5-4. AISD Schools and Facilities Vulnerable to Flooding



AISD schools that are located in the floodplain and are vulnerable to flood include: Austin High, Covington Middle, House Park, Martin Middle, Oak Hill Elementary, Ortega Elementary, Palm Elementary, and Reilly Elementary.

Historic loss estimates for damage caused by a flood event (in 2015 dollars) is \$104,695,845, having an approximate annual loss estimate of \$5,816,436. Historic loss estimates are based on data that has been reported and recorded, therefore there could be damages that were not reported and therefore not accounted for in the historic loss estimates. Considering 76 flood events over an 18-year period, frequency is approximately four events every year.

## NFIP Participation

Flood insurance offered through the National Flood Insurance Program (NFIP) is the best way for home and business owners to protect themselves financially against the flood hazard. The City of Austin participates in the NFIP. The AISD falls under the City of Austin NFIP area. As an additional indicator of floodplain management responsibility, communities may choose to participate in FEMA's Community Rating System (CRS). This is an incentive-based program that allows communities to undertake flood mitigation activities that go beyond NFIP requirements. The City of Austin participates in the CRS program to provide flood insurance incentives and expand the community's current NFIP

## Section 5: Flood

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policy base, and reduce risk through the adoption of higher regulatory standards. The City of Austin has previously acquired and continues to acquire numerous structures that have experienced one or more floods resulting in substantial damage, in an effort to protect open space adjacent to floodplains.

The Legislature of the State of Texas has, in Section 16.315, Texas Water Code, delegates the responsibility to local government units to adopt regulations designed to minimize flood losses. The City of Austin has adopted ordinances to regulate the floodplain, or any land area susceptible to being inundated by water from any source. The City of Austin's floodplain ordinances go above and beyond the requirement of the NFIP.

The City of Austin is currently engaged in floodplain buyouts in the Onion Creek watershed. Current mitigation projects include: buyouts, upgrading of low water crossings (Old San Antonio Rd.), several local flood projects under construction, Waller Creek tunnel project, and others.

Additionally mitigation by the City of Austin includes the reduction in flood losses created by the cumulative effect of obstructions in floodplains which cause an increase in flood heights and velocities, and by the occupancy of flood hazard areas by uses vulnerable to floods and hazardous to other lands because they are inadequately elevated, flood-proofed or otherwise protected from flood damage.

The City of Austin promotes public health, safety, and general welfare; and minimizes public and private losses due to flood conditions in specific areas by provisions designed to:

- Protect human life and health;
- Minimize expenditure of public money for costly flood control projects;
- Minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;
- Minimize prolonged business interruptions;
- Minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets and bridges located in floodplains;
- Help maintain a stable tax base by providing for the sound use and development of flood-prone areas in such a manner as to minimize future flood blight areas; and
- Ensure that potential buyers are notified that property is in a flood area.

In order to accomplish these tasks, the City of Austin follows these guidelines:

- Restrict or prohibit uses that are dangerous to health, safety or property in times of flood, or cause excessive increases in flood heights or velocities;
- Require that uses vulnerable to floods, including facilities, which serve such uses, be protected against flood damage at the time of initial construction;
- Control the alteration of natural floodplains, stream channels, and natural protective barriers, which are involved in the accommodation of floodwaters;
- Control filling, grading, dredging and other development, which may increase flood damage; and
- Prevent or regulate the construction of flood barriers which will unnaturally divert floodwaters or which may increase flood hazards to other lands.

### NFIP Compliance and Maintenance

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As part of continual compliance with the NFIP, the City of Austin has developed a Floodplain Management Plan and has a current NFIP ordinance. The Flood Damage Prevention Ordinance was revised and updated in 2008. The City of Austin also periodically conducts education programs for

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area homebuilders and through public outreach to increase awareness of the FEMA requirements for Flood Plain Management.

As part of the NFIP Program, and in conjunction with developing new mitigation actions for the Plan Update, the City of Austin has implemented mitigation projects related to compliance and maintenance associated with the NFIP program.

The City of Austin has also developed new mitigation actions that relate to NFIP compliance. These actions can be found in Section 24.

Flooding was identified as a high risk hazard during hazard ranking activities at the Risk Assessment Workshop by the Planning Team and many of the new mitigation actions were developed with flood mitigation in mind. A majority of the flood mitigation actions address reducing flood risk through structural alterations and drainage projects, and implementing flood awareness programs. The City of Austin recognizes the need for and is adopting higher NFIP regulatory standards to further minimize flood risk in their community.

The prioritization method for implementing actions was based on FEMA's STAPLEE criteria, which stands for Social, Technical, Administrative, Political, Legal, Economic and Environmental criteria. As a result of this exercise, an overall priority was assigned to each mitigation action by each Planning Team member. The overall priority assigned to each mitigation action is reflected in Section 24 for the City of Austin and Austin Independent School District (AISD). While prioritizing mitigation actions many factors should be considered including specific mitigation actions to implement following a major disaster, ease of implementation by the community, cost of the project compared to the perceived benefit, timeframe for implementing the action, and available personnel to oversee and implement the project.

### Repetitive Loss

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The Severe Repetitive Loss (SRL) Grant Program under FEMA provides federal funding to assist states and communities in implementing mitigation measures to reduce or eliminate the long-term risk of flood damage to SRL residential structures insured under the NFIP. The Texas Water Development Board (TWDB) administers the SRL grant program for the State of Texas.

Severe Repetitive Loss properties are defined as residential properties that are:

- covered under the NFIP and have at least four flood related damage claim payments (building and contents) over \$5,000 each, and
- the cumulative amount of such claims payments exceed \$20,000; or
- at least two separate claim payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

In either scenario, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.<sup>4</sup> Table 5-7 shows repetitive loss and severe repetitive loss properties for the City of Austin. Currently, there are no repetitive loss and severe repetitive loss properties for the AISD according to the Texas Water Development Board.

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<sup>4</sup> Source: Texas Water Development Board

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**Table 5-7. Repetitive Loss and Severe Repetitive Loss Properties**

JURISDICTION	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR <sup>5</sup>
City of Austin	SDF	ASSMD CONDO	4	\$301,673.60	PN
City of Austin	NO	SINGLE FMLY	4	\$24,331.66	-
City of Austin	NO	SINGLE FMLY	2	\$98,125.20	-
City of Austin	NO	SINGLE FMLY	2	\$21,331.97	-
City of Austin	NO	SINGLE FMLY	3	\$17,573.40	-
City of Austin	NO	SINGLE FMLY	3	\$33,839.82	-
City of Austin	NO	ASSMD CONDO	2	\$50,403.08	-
City of Austin	NO	SINGLE FMLY	2	\$9,539.18	-
City of Austin	NO	SINGLE FMLY	2	\$39,169.67	-
City of Austin	NO	SINGLE FMLY	2	\$94,253.32	-
City of Austin	NO	SINGLE FMLY	2	\$39,472.69	-
City of Austin	YES	SINGLE FMLY	2	\$32,751.22	-
City of Austin	YES	SINGLE FMLY	2	\$42,613.02	-
City of Austin	NO	SINGLE FMLY	2	\$221,765.95	-
City of Austin	YES	SINGLE FMLY	3	\$14,600.65	-
City of Austin	YES	SINGLE FMLY	4	\$38,227.55	-
City of Austin	NO	SINGLE FMLY	2	\$5,274.53	-
City of Austin	NO	SINGLE FMLY	2	\$71,377.89	-
City of Austin	NO	SINGLE FMLY	2	\$11,711.85	-
City of Austin	YES	SINGLE FMLY	3	\$13,589.24	-
City of Austin	SDF	NON RESIDNT	4	\$38,299.46	VN
City of Austin	NO	SINGLE FMLY	2	\$28,868.32	-
City of Austin	YES	SINGLE FMLY	2	\$58,183.70	-

<sup>5</sup> In this column: “V” stands for “Validated”; “VN” stands for “Validated Nonresidential”; “VU” stand for “Validated Uninsured”; “VNU” stands for “Validated Nonresidential Uninsured”; “P” stands for “Pending”; “PU” stands for “Pending Uninsured”; and “PN” stands for “Pending Nonresidential”.

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JURISDICTION	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR <sup>5</sup>
City of Austin	YES	SINGLE FMLY	2	\$42,135.44	-
City of Austin	NO	SINGLE FMLY	3	\$35,791.61	-
City of Austin	NO	SINGLE FMLY	2	\$7,284.35	-
City of Austin	YES	SINGLE FMLY	2	\$15,831.72	-
City of Austin	NO	SINGLE FMLY	2	\$22,398.68	-
City of Austin	YES	SINGLE FMLY	2	\$3,675.77	-
City of Austin	NO	SINGLE FMLY	3	\$58,226.75	-
City of Austin	NO	SINGLE FMLY	2	\$36,863.38	-
City of Austin	NO	SINGLE FMLY	2	\$28,038.36	-
City of Austin	NO	SINGLE FMLY	3	\$68,306.95	-
City of Austin	NO	SINGLE FMLY	2	\$20,421.75	-
City of Austin	NO	SINGLE FMLY	2	\$41,200.26	-
City of Austin	NO	SINGLE FMLY	2	\$53,321.47	-
City of Austin	NO	SINGLE FMLY	2	\$20,433.64	-
City of Austin	YES	SINGLE FMLY	2	\$12,410.32	-
City of Austin	NO	SINGLE FMLY	2	\$69,004.91	-
City of Austin	YES	SINGLE FMLY	2	\$153,187.43	-
City of Austin	NO	SINGLE FMLY	2	\$136,428.21	-
City of Austin	YES	SINGLE FMLY	3	\$5,947.10	-
City of Austin	NO	SINGLE FMLY	2	\$8,959.29	-
City of Austin	YES	OTHER RESID	2	\$6,698.13	-
City of Austin	YES	OTHER RESID	3	\$87,217.30	-
City of Austin	NO	SINGLE FMLY	3	\$7,724.62	-
City of Austin	YES	SINGLE FMLY	3	\$97,793.58	-
City of Austin	YES	SINGLE FMLY	2	\$51,561.24	-
City of Austin	NO	SINGLE FMLY	2	\$11,116.01	-

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JURISDICTION	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR <sup>5</sup>
City of Austin	YES	SINGLE FMLY	2	\$29,996.57	-
City of Austin	NO	SINGLE FMLY	2	\$10,282.68	-
City of Austin	YES	SINGLE FMLY	2	\$17,155.24	-
City of Austin	YES	ASSMD CONDO	2	\$197,449.70	-
City of Austin	NO	NON RESIDNT	2	\$15,546.84	-
City of Austin	SDF	NON RESIDNT	8	\$579,305.01	VN
City of Austin	YES	NON RESIDNT	4	\$109,562.13	-
City of Austin	SDF	NON RESIDNT	4	\$66,527.39	VN
City of Austin	YES	NON RESIDNT	2	\$20,024.74	-
City of Austin	NO	NON RESIDNT	4	\$121,788.66	-
City of Austin	YES	NON RESIDNT	4	\$123,826.01	-
City of Austin	NO	SINGLE FMLY	6	\$36,545.36	-
City of Austin	NO	SINGLE FMLY	3	\$28,767.88	-
City of Austin	YES	SINGLE FMLY	3	\$133,439.10	-
City of Austin	YES	SINGLE FMLY	2	\$50,667.38	-
City of Austin	NO	SINGLE FMLY	2	\$11,331.38	-
City of Austin	NO	SINGLE FMLY	3	\$16,805.29	-
City of Austin	NO	SINGLE FMLY	2	\$16,060.56	-
City of Austin	NO	SINGLE FMLY	3	\$59,490.90	-
City of Austin	NO	SINGLE FMLY	2	\$3,014.38	-
City of Austin	YES	SINGLE FMLY	2	\$13,226.60	-
City of Austin	YES	SINGLE FMLY	2	\$87,378.92	-
City of Austin	NO	SINGLE FMLY	2	\$63,067.47	PU
City of Austin	YES	SINGLE FMLY	2	\$140,845.13	-
City of Austin	YES	SINGLE FMLY	3	\$147,986.55	-
City of Austin	YES	SINGLE FMLY	3	\$88,511.34	-

## Section 5: Flood

JURISDICTION	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR <sup>5</sup>
City of Austin	NO	OTHER RESID	2	\$2,421.34	-
City of Austin	YES	SINGLE FMLY	2	\$30,846.35	-
City of Austin	NO	SINGLE FMLY	2	\$39,733.60	-
City of Austin	NO	SINGLE FMLY	2	\$38,054.74	-
City of Austin	SDF	SINGLE FMLY	6	\$127,612.31	V
City of Austin	NO	SINGLE FMLY	2	\$184,808.46	-
City of Austin	NO	NON RESIDNT	3	\$130,075.28	-
City of Austin	NO	SINGLE FMLY	5	\$23,397.98	-
City of Austin	SDF	NON RESIDNT	10	\$188,557.76	VN
City of Austin	NO	SINGLE FMLY	2	\$13,212.52	-
City of Austin	NO	NON RESIDNT	2	\$27,499.86	-
City of Austin	YES	NON RESIDNT	2	\$29,057.71	-
City of Austin	NO	NON RESIDNT	2	\$47,942.80	-
City of Austin	YES	NON RESIDNT	3	\$6,823.20	-
City of Austin	NO	SINGLE FMLY	2	\$11,481.40	-
City of Austin	NO	2-4 FAMILY	2	\$74,095.04	-
City of Austin	NO	NON RESIDNT	2	\$8,090.87	-
City of Austin	NO	SINGLE FMLY	2	\$3,721.91	-
City of Austin	NO	NON RESIDNT	2	\$6,735.82	-
City of Austin	NO	SINGLE FMLY	2	\$24,297.46	-
City of Austin	NO	SINGLE FMLY	3	\$58,876.66	-
City of Austin	NO	SINGLE FMLY	3	\$23,983.53	-
City of Austin	NO	SINGLE FMLY	3	\$79,714.67	-
City of Austin	NO	SINGLE FMLY	2	\$65,891.04	-
City of Austin	NO	ASSMD CONDO	2	\$122,230.76	-
City of Austin	NO	2-4 FAMILY	2	\$6,436.20	-

## Section 5: Flood

JURISDICTION	INSURED?	BUILDING TYPE	LOSSES	TOTAL PAID	SRL INDICATOR <sup>5</sup>
City of Austin	NO	SINGLE FMLY	2	\$38,036.00	-
City of Austin	NO	SINGLE FMLY	4	\$18,969.28	-
City of Austin	NO	NON RESIDNT	2	\$29,306.75	-
City of Austin	NO	NON RESIDNT	2	\$11,800.40	-
City of Austin	NO	NON RESIDNT	2	\$79,366.00	-
City of Austin	NO	NON RESIDNT	2	\$42,124.04	-
City of Austin	NO	NON RESIDNT	3	\$158,416.35	-
City of Austin	YES	SINGLE FMLY	3	\$7,038.58	-
City of Austin	YES	ASSMD CONDO	3	\$105,936.96	-
City of Austin	YES	SINGLE FMLY	2	\$4,093.03	-
City of Austin	YES	SINGLE FMLY	4	\$64,804.03	-
City of Austin	YES	SINGLE FMLY	4	\$109,525.27	MV
City of Austin	NO	SINGLE FMLY	2	\$22,140.86	-
City of Austin	NO	SINGLE FMLY	4	\$28,403.62	-
City of Austin	NO	SINGLE FMLY	2	\$18,362.51	-
City of Austin	NO	SINGLE FMLY	2	\$10,787.58	-
City of Austin	NO	SINGLE FMLY	3	\$4,500.54	-

# Section 6: Drought

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## Hazard Description

Drought is a period of time without substantial rainfall that persists from one year to the next. Drought is a normal part of virtually all climatic regions, including areas with high and low average rainfall. Drought is the consequence of anticipated natural precipitation reduction over an extended period of time, usually a season or more in length. Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Table 6-1 presents definitions for these different types of drought.



Source: <https://www.austintexas.gov/department/water>

**Table 6-1. Drought Classification Definitions<sup>1</sup>**

<b>METEOROLOGICAL DROUGHT</b>	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
<b>HYDROLOGIC DROUGHT</b>	The effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
<b>AGRICULTURAL DROUGHT</b>	Soil moisture deficiencies relative to water demands of plant life, usually crops.
<b>SOCIOECONOMIC DROUGHT</b>	The effect of demands for water exceeding the supply as a result of a weather-related supply shortfall.

Droughts are one of the most complex of all natural hazards because it is difficult to determine the precise beginning or ending of the event. Additionally, droughts can lead to other hazards such as extreme heat and wildfires. The impact of a drought event on wildlife and farming is enormous, often killing crops, grazing land, edible plants, and trees, in severe cases. A secondary hazard to drought

<sup>1</sup> Source: Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy, FEMA

## Section 6: Drought

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is wildfire because dying vegetation serves as a prime ignition source. Therefore, a heat wave combined with a drought can pose a high risk to the planning area.

### Location

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Droughts are a normal condition that occur regularly throughout Texas and the City of Austin planning area. However, drought events can vary greatly in intensity and duration. There is no distinct geographic boundary to drought; therefore, it can occur throughout the entire City of Austin planning area and Austin Independent School District (AISD) equally.

### Extent

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The Palmer Drought Severity Index is used to measure the extent of drought by measuring the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, thus the intensity of a drought during a single month is dependent upon that month's weather patterns plus the cumulative weather patterns of previous months. The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop. Table 6-2 provides classification descriptions for the Palmer Drought Severity Index, and Table 6-3 depicts the magnitude of drought according to the Index. .

**Table 6-2. Palmer Drought Severity Index - Category Descriptions<sup>2</sup>**

CATEGORY	DESCRIPTION	POSSIBLE IMPACTS	PALMER DROUGHT SEVERITY INDEX
<b>D0</b>	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.	-1.0 to -1.9
<b>D1</b>	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested.	-2.0 to -2.9
<b>D2</b>	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed.	-3.0 to -3.9
<b>D3</b>	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions.	-4.0 to -4.9
<b>D4</b>	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; shortages of water in reservoirs, streams, and wells, creating water emergencies.	-5.0 or less

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<sup>2</sup> Source: National Drought Mitigation Center

## Section 6: Drought

**Table 6-3. Palmer Drought Severity Index**

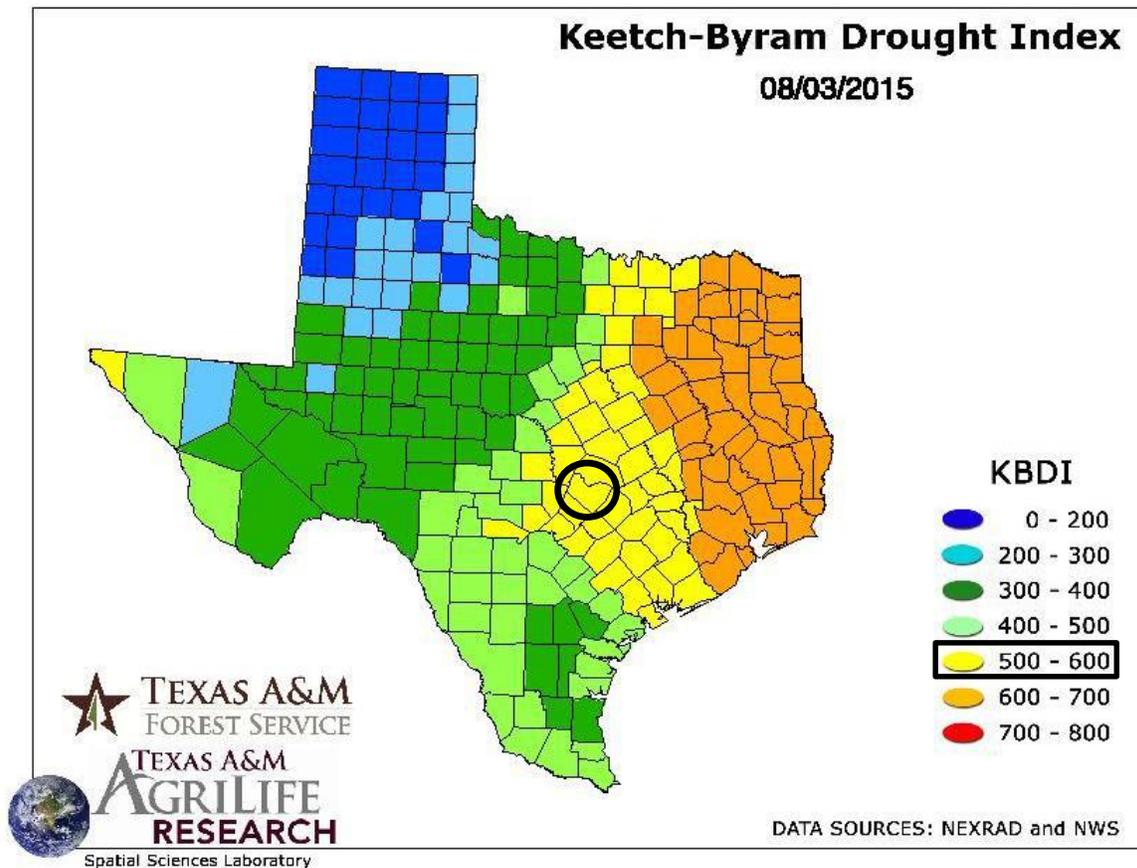
PALMER DROUGHT SEVERITY INDEX	DROUGHT CONDITION CLASSIFICATIONS						
	Extreme	Severe	Moderate	Normal	Moderately Moist	Very Moist	Extremely Moist
<b>Z Index</b>	-2.75 and below	-2.00 to -2.74	-1.25 to -1.99	-1.24 to +.99	+1.00 to +2.49	+2.50 to +3.49	n/a
<b>Meteorological</b>	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above
<b>Hydrological</b>	-4.00 and below	-3.00 to -3.99	-2.00 to -2.99	-1.99 to +1.99	+2.00 to +2.99	+3.00 to +3.99	+4.00 and above

Drought is monitored nationwide by the National Drought Mitigation Center (NDMC). Indicators are used to describe broad scale drought conditions across the U.S. Indicators correspond to the intensity of drought.

Based on historical occurrences for drought and the location of the City of Austin and AISD, the planning area can anticipate a range of drought from severe drought to exceptional drought or D2 to D4 based on the Palmer Drought Severity Index.

The Texas Forest Service uses the Keetch-Byram Drought Index to determine the fire potential based on daily water balance, precipitation and soil moisture. Figure 6-1 shows the Texas Drought Index according to Keetch-Byram Drought Index, which uses a rating classification that is color coded with a scale of 0 to 800 (Low risk to high risk).

Figure 6-1. Texas Drought Index according to Keetch-Byram Drought Index



The Travis County average including the City of Austin planning area, is at moderate risk (Figure 6-1). Which means fire intensity begins to significantly increase...and fires will readily burn in all directions, exposing mineral soils in some locations.

## Historical Occurrences

The City of Austin planning area can typically experience a severe drought. Table 6-4 and 6-5 lists historical events that have occurred in Travis County as reported in the National Climatic Data Center (NCDC) and the Spatial Hazard Events & Losses Database for the United States (SHELDUS). Historical drought information, as provided by the NCDC and SHELDUS, show drought activity across a multi-county forecast area for each event, the appropriate percentage of the total property and crop damage reported for the entire forecast area has been allocated to each county impacted by the event.

Only drought events that have been reported have been factored into this Risk Assessment. It is likely that additional drought occurrences have gone unreported before and during the recording period. Tables 6-4 and 6-5 show historical incident information for the City of Austin planning area which resulted in property or crop damage from January 1996 to November 2014.

**Table 6-4. Historical Drought Years, 1977-2014**

DROUGHT YEAR
1977
1996
2000
2011
2012
2013
2014
<b>10 unique events</b>

**Table 6-5. Historical Drought Events Resulting in Property or Crop Damage, 1977-2014<sup>3</sup>**

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Travis County	5/1/1977	0	0	27,543	\$275,435
Travis County	4/1/1996	0	0	\$3,639,189	\$7,278,377

### Significant Past Events

#### March 1, 2013 – Travis County, City of Austin

March of 2013 was a dry month across South Central Texas. Most of the region received less than normal rainfall with most of the southern and western areas getting less than 25 percent of normal. In addition to the dry month, March ended a dry six month period from October 2012 through March 2013. These six months ranked in the ten driest October to March periods at Del Rio, Austin Camp Mabry, and Austin Bergstrom International Airport. As a result, the drought worsened in 13 counties and only Atascosa and Frio Counties remained in the severe category (Stage D2) drought. Maverick County moved into the exceptional category (Stage D4); Bastrop, Caldwell, Dimmit, Fayette, Gonzales, Guadalupe, Williamson, and Zavala counties moved to extreme (Stage D3); and Bexar, Lavaca, Medina, and Wilson counties moved to severe (Stage D2). Edwards, Kinney and Val Verde counties remained in exceptional (Stage D4); Hays, Kerr, and Real counties remained in extreme (Stage D3); and Bandera, Blanco, Burnet, Comal, De Witt, Gillespie, Karnes, and Kendall counties remained in severe (Stage D2). Fire danger at the end of the month was low to moderate due to rain toward the end of March. Of the counties in Stage D2 or worse drought, 14 had outdoor burn bans in

<sup>3</sup> Only recorded events with fatalities, injuries, or damages are listed.

## Section 6: Drought

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effect at the end of the month. These were Bexar, Dimmit, Edwards, Guadalupe, Hays, Karnes, Kendall, Kinney, Maverick, Medina, Travis, Uvalde, Val Verde, and Wilson. The Texas Crop and Weather Report issued by Texas A&M Agricultural indicated soil moisture was a problem in dry land corn, sorghum, and cotton. Area lakes and reservoirs continued below normal pool elevations with Lake Amistad around 52 feet below normal, Lake Travis 50 feet below normal, and Medina Lake nearly 80 feet below normal which left it at 6.5 percent of capacity. The Edwards Aquifer was 19.9 feet below normal, and 4.7 feet below the level it was at the end of March 2013.

### **June 1, 2012 – Travis County, City of Austin**

A lack of rainfall resulted in 21 counties in South Central Texas going back into severe or extreme drought conditions. Most of these counties received one half inch or less of rain during the month. Williamson County moved into extreme drought category (State D3) while the other counties went to severe category (Stage D2). Eleven counties had burn bans in effect, and fire danger at the end of the month was moderate to high. The Texas crop and weather report issued by Texas A&M Agricultural indicated conditions were very dry, and damage from grasshoppers was high. Brush was showing signs of heat and water stress and was losing color. Pastures deteriorated, and row crops began to show moisture stress. Area lakes and reservoirs started to fall again and were generally well below normal pool elevations with Lake Travis around 40 feet below normal and Medina Lake 55 feet below normal. The seven day stream flow average over most of the region was in the below normal range, but the Upper Guadalupe and Lower Colorado basins were much below normal. The Edwards Aquifer was 22 feet below normal.

### **May 1, 2011 – Travis County, City of Austin**

During May of 2011 most of the area was in exceptional drought conditions (Stage D4). Lack of rain this month moved Bandera, Bexar, Blanco, Caldwell, Comal, Frio, Gillespie, Gonzales, Guadalupe, Hays, Kendall, Medina, Travis, and Williamson counties into this stage and De Witt and Karnes counties into extreme drought conditions (Stage D3). This means all of South Central Texas was in either extreme or exceptional drought conditions. Fire danger in South Central Texas remained moderate to high and burn bans were in effect for all of the counties except Llano. The Texas A&M agricultural program report indicated the agricultural situation was rapidly deteriorating. Forage availability remained below average. Many stock tanks remained extremely low and some were in danger of drying up. At the end of the month the seven day stream flow average remained in the below or much below normal range for basins across South Central Texas and the Rio Grande Plains. The Rio Grande was in normal stream flow. Area lakes and reservoirs remained below normal pool elevations with Lake Travis around 32 feet below normal and Medina Lake near 27 feet below normal. The Edwards Aquifer was 20.4 feet below normal and 29.3 feet below the level from one year ago. The San Antonio Water System moved into Stage 2 water restrictions, the City of Kerrville was in Stage 3, the City of San Marcos was in Stage 2, and the City of Austin was in Stage 1. Many other communities across South Central Texas continued with some level of water restrictions.

## Probability of Future Events

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Based on 10 recorded drought events over the 37-year reporting period only two events resulted in property or crop damage. Thus, the City of Austin planning area, including AISD, averages one drought every three years. This frequency supports a likely probability of future events.

## Vulnerability and Impact

Loss estimates were based on 37 years of statistical data from the NCDC and SHELDUS. A drought event frequency-impact was then developed to determine an impact profile on agriculture products and estimate potential losses due to drought in the area. Only drought events that have been reported have been factored into this Risk Assessment. It is likely that additional drought occurrences have gone unreported before and during this recording period. Table 6-6 shows annualized exposure based on historical incident information which resulted in property or crop damage.

**Table 6-6. Drought Event Damage Totals, 1977-2014**

JURISDICTION	NUMBER OF EVENTS	PROPERTY DAMAGES	CROP DAMAGES	PROPERTY DAMAGES (2015 DOLLARS)	CROP DAMAGES (2015 DOLLARS)
Travis County	2	\$2,450,244.08	\$4,956,786.17	\$3,666,347.44	\$7,305,536.01
<b>TOTAL LOSSES:</b>		<b>\$7,407,010.25</b>		<b>\$10,971,883.45</b>	

Drought impacts large areas and crosses jurisdictional boundaries. All existing and future buildings, facilities and populations are exposed to this hazard and could potentially be impacted. However, drought impacts are mostly experienced as water shortages, crop and livestock losses on agricultural lands, and typically have no impact on buildings.

The population, agriculture, property, and environment are all vulnerable to drought. The average person will survive only a few days without water, and this timeframe can be drastically shortened for those people with more fragile health including children, the elderly, and the ill. The population is also vulnerable to food shortages when drought conditions exist and potable water is in short supply. Potable water is used for drinking, sanitation, patient care, sterilization, equipment, heating and cooling systems, and many other essential functions in medical facilities.

The entire City of Austin, including AISD’s population is vulnerable to drought with the planning area being dependent on the Colorado River (river water is pulled from Lake Travis and Lake Austin) as their only water source. During a drought, the lakes can have low inflows of water. This would affect both the City and AISD because it could limit drinking water, and water for landscaping. The City of Austin also has a powerplant on Lady Bird Lake, which could also be vulnerable to drought as it could impact the power source.

While all residents of Austin could be adversely affected by drought conditions, which could limit water supplies and present health threats, elderly persons, small children, infants and the chronically ill who do not have adequate cooling units in their homes may become more vulnerable to injury and/or death.

All 142 AISD campuses could also be impacted by drought conditions however, the 84 AISD elementary campuses could be more vulnerable due to the higher population of small children. In addition, AISD athletic facilities could see an increase in risk to all students participating in outdoor athletic functions and events. The economic impact of drought events can be significant and produce complex impacts in various sectors of the economy beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. If a drought event extends over a number of years, the direct and indirect economic impact can be significant. Based on the 10 reported previous occurrences and potential exposure for the hazard, the

## Section 6: Drought

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potential severity of impact of droughts is “Limited” with less than 10 percent of property destroyed and has resulted in no injuries or fatalities. Annualized loss over the 64-year reporting period in Travis County is \$296,537 annually.

# Section 7: Wildfire

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## Hazard Description

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A wildfire event can be a potentially damaging consequence of drought. A wildfire event can rapidly spread out of control and occurs most often in the summer, when the brush is dry and flames can move unchecked through a highly vegetative area. Wildfires can start as a slow burning fire along the forest floor, killing and damaging trees. The fires often spread more rapidly as they reach the tops of trees, with wind carrying the flames from tree to tree. Usually, dense smoke is the first indication of a wildfire.

A wildfire event often begins unnoticed and spreads quickly, lighting brush, trees and homes on fire. For example, a wildfire may be started by a campfire that was not doused properly, a tossed cigarette, burning debris, or arson.

Texas has seen a significant increase in the number of wildfires in the past 30 years, which included wildland, interface, or intermix fires. Wildland Urban Interface or Intermix (WUI) fires occur in areas where structures and other human improvements meet or intermingle with undeveloped wildland or vegetative fuels.

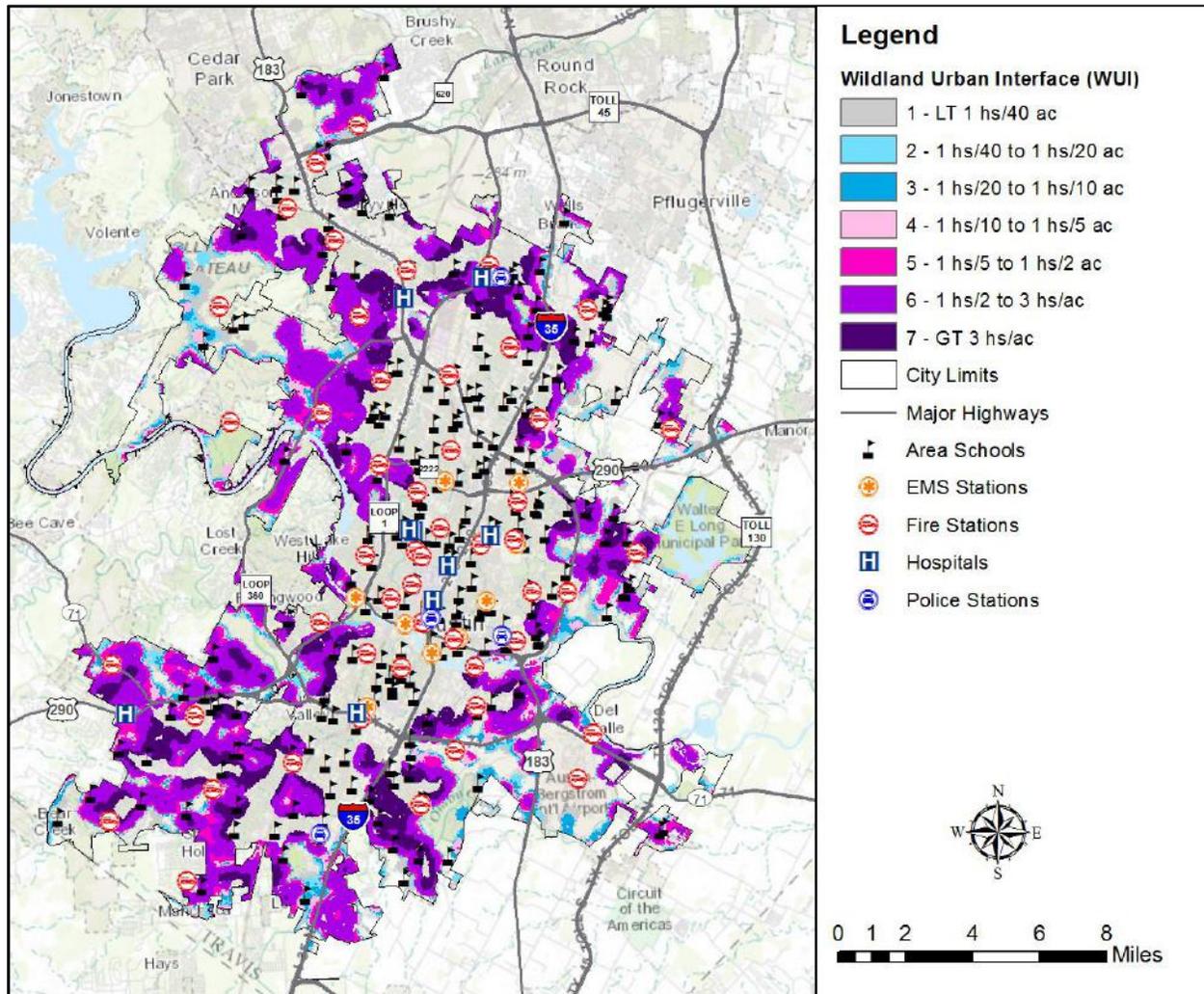
## Location and Historical Occurrences

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Wildfires can vary greatly in terms of size, location, intensity and duration. While wildfires are not confined to any specific geographic location, they are most likely to occur in open grasslands. The threat to people and property from a wildfire event is greater in the fringe areas where developed areas meet open grass lands, such as the WUI (Figure 7-1). It is estimated that 34.5 percent of the total population in the City of Austin live within the WUI. However, the entire City of Austin planning area is equally at risk for wildfires.

## Section 7: Wildfire

**Figure 7-1. Wildland Urban Interface Map – City of Austin and AISD**

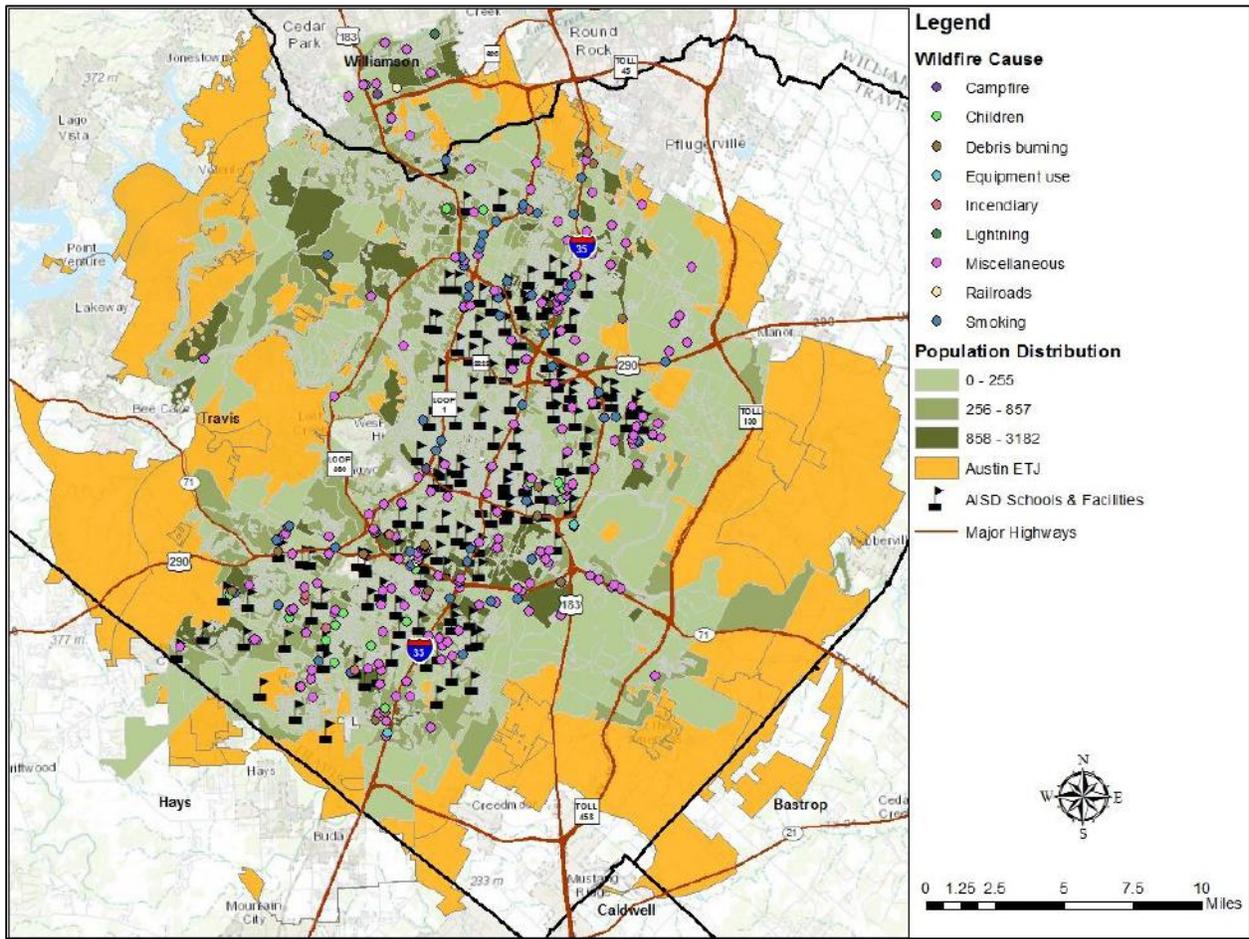


From 2005 to 2015 the Texas Forest Service (TFS) database reported 305 wildfire events within the City of Austin boundaries. TFS started collecting wildfire data in 1985, but volunteer fire departments did not start reporting events until 2005. Due to lack of reporting prior to 2005, frequency calculations were based on a 10 year period, and only data received during those years were included in the calculations. The map below shows approximate locations of wildfires, which can be grass or brushfires of any size (Figure 7-2). Tables 7-1 thru 7-3 provide information (provided by local volunteer fire departments) on number of wildfires by ignition causes, number of fires reported by year, number of fires by month, and acreage of suppressed wildfire by year.

Historical wildfire data for the following are provided within a City-wide basis per the National Climatic Data Center (NCDC) and Spatial Hazard Events & Losses Database for the United States (SHELDUS) databases; Austin Independent School District (AISD) is included in data for the City of Austin.

# Section 7: Wildfire

## Figure 7-2. Location and Historic Wildfire Events for Austin and AISD



## Section 7: Wildfire

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**Table 7-1. Number of Wildfires by Cause for Austin**

CAUSE	NUMBER
Miscellaneous <sup>1</sup>	195
Debris Burning	12
Equipment Use	4
Children	17
Campfire	4
Smoking	60
Lightning	1
Incendiary	9
Railroads	3
<b>TOTAL</b>	<b>305</b>

**Table 7-2. Acreage of Suppressed Wildfire by Year**

JURISDICTION	2005	2006	2007	2008	2009
City of Austin	32	124.1	46	249	24.1

**Table 7-3. Number of Wildfires by Year**

JURISDICTION	2005	2006	2007	2008	2009
City of Austin	27	108	42	112	16

It is important to note that the AISD includes schools and facilities within the City of Austin planning area. There may be some occurrences that have occurred for the AISD and may not have been recorded, but are included in the City of Austin occurrence data because of their location.

**Table 7-4. AISD Wildfire Events, Criminal Mischief and Arson<sup>2</sup>**

JURISDICTION	2009-2010	2010-2011	2011-2012	2012-2013
AISD	37	28	45	20

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<sup>1</sup> A miscellaneous cause includes fires of an origin other than lightning, campfire, smoking, debris burning, incendiary/arson, equipment use, railroads, and children.

<sup>2</sup> Page 21: [https://www.austinisd.org/sites/default/files/dept/cda/docs/district-tapr/2012-2013/ratings\\_TAPR\\_03\\_Annual\\_Report\\_2013.pdf](https://www.austinisd.org/sites/default/files/dept/cda/docs/district-tapr/2012-2013/ratings_TAPR_03_Annual_Report_2013.pdf)

## Section 7: Wildfire

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Other reports from the AISD include a fire in the Campus Advisory Council Building on October 19, 2012 and an arson incident at Cunningham Campus on March 31, 2014.

### Significant Past Events

#### September 4, 2011 – Steiner Ranch Wildfire

The Steiner Ranch Wildfire started on September 4, 2011 behind Tropical Storm Lee and a cold front that brought northerly winds. The peak wind at Austin Bergstrom International Airport was 36 mph. The fire burned 125 acres, destroyed 24 homes, and damaged 30 others.

#### April 17, 2011 – Oak Hill Wildfire

A human caused wildfire started around noon in the Oak Hill area of southwest Austin. The Oak Hill fire burned 100 acres and spread to nearby neighborhoods. Eleven homes were destroyed and 10 others were damaged. Most of the damage occurred on South Brook Drive and Callbram Lane. At the peak of the fire, 450 homes were threatened and 100 firefighters were fighting the fire, which is approximately half of the Austin Fire Department.

### Extent

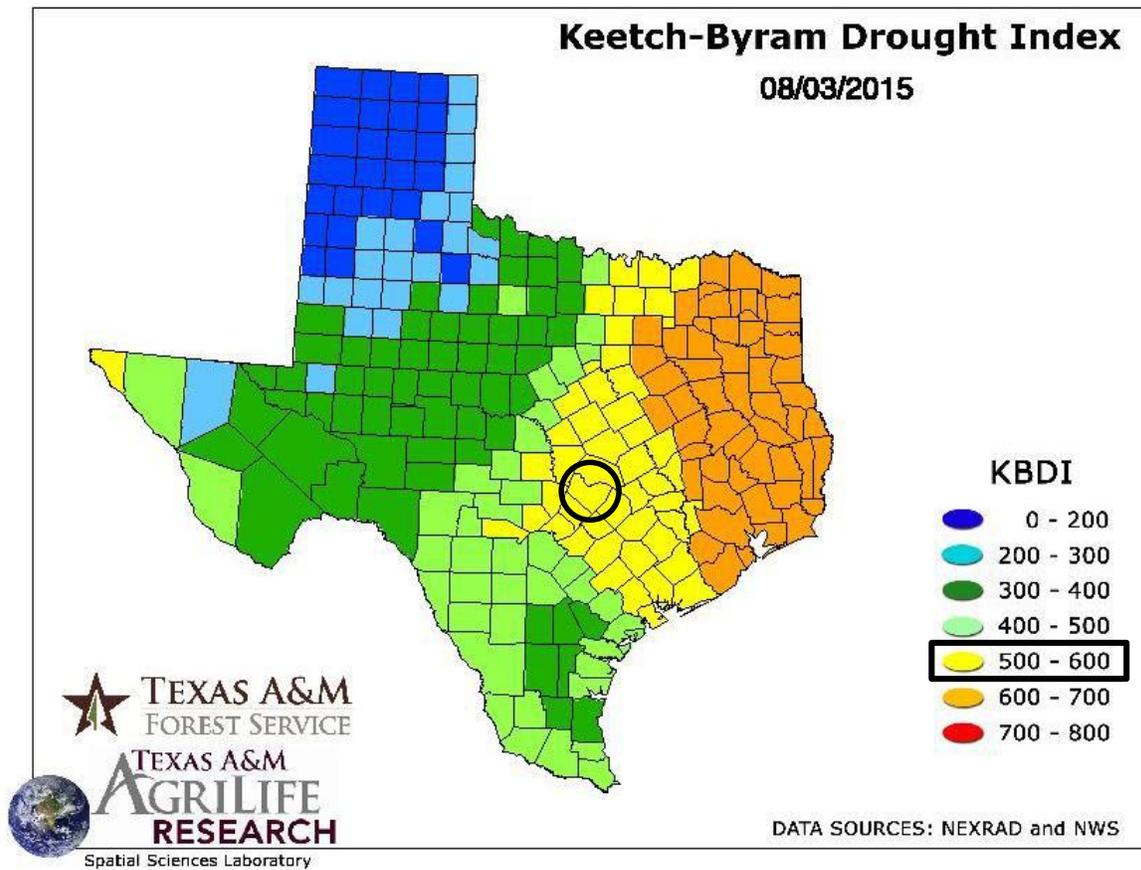
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Risk for a wildfire event is measured in terms of magnitude and intensity using the Keetch Byram Drought Index (KBDI), a mathematical system for relating current and recent weather conditions to potential or expected fire behavior. The KBDI determines forest fire potential based on a daily water balance, derived by balancing a drought factor with precipitation and soil moisture (assumed to have a maximum storage capacity of eight inches), and is expressed in hundredths of an inch of soil moisture depletion.

Each color in Figure 7-3 represents the KBDI at that location and the City of Austin is depicted within the circle. The KBDI ranges from 0 to 800. A KBDI of 0 represents no moisture depletion, and a KBDI of 800 represents absolutely dry conditions.

Figure 7-3. Keetch-Byram Drought Index (KBDI) for the State of Texas, 2015<sup>3</sup>



The Texas A&M Forest Services describes the KBDI at four distinct levels:

- **0 - 200:** Soil and fuel moisture are high. Most fuels will not readily ignite or burn. However, with sufficient sunlight and wind, cured grasses and some light surface fuels will burn in spots and patches.
- **200 - 400:** Fires more readily burn and will carry across an area with no gaps. Heavier fuels will not readily ignite and burn. Expect smoldering and the resulting smoke to carry into and possibly through the night.
- **400 - 600:** Fires intensity begins to significantly increase. Fires will readily burn in all directions exposing mineral soils in some locations. Larger fuels may burn or smolder for several days creating possible smoke and control problems.
- **600 - 800:** Fires will burn to mineral soil. Stumps will burn to the end of underground roots and spotting will be a major problem. Fires will burn through the night and heavier fuels will actively burn and contribute to fire intensity.<sup>4</sup>

<sup>3</sup> <http://twc.tamu.edu/kbdi>

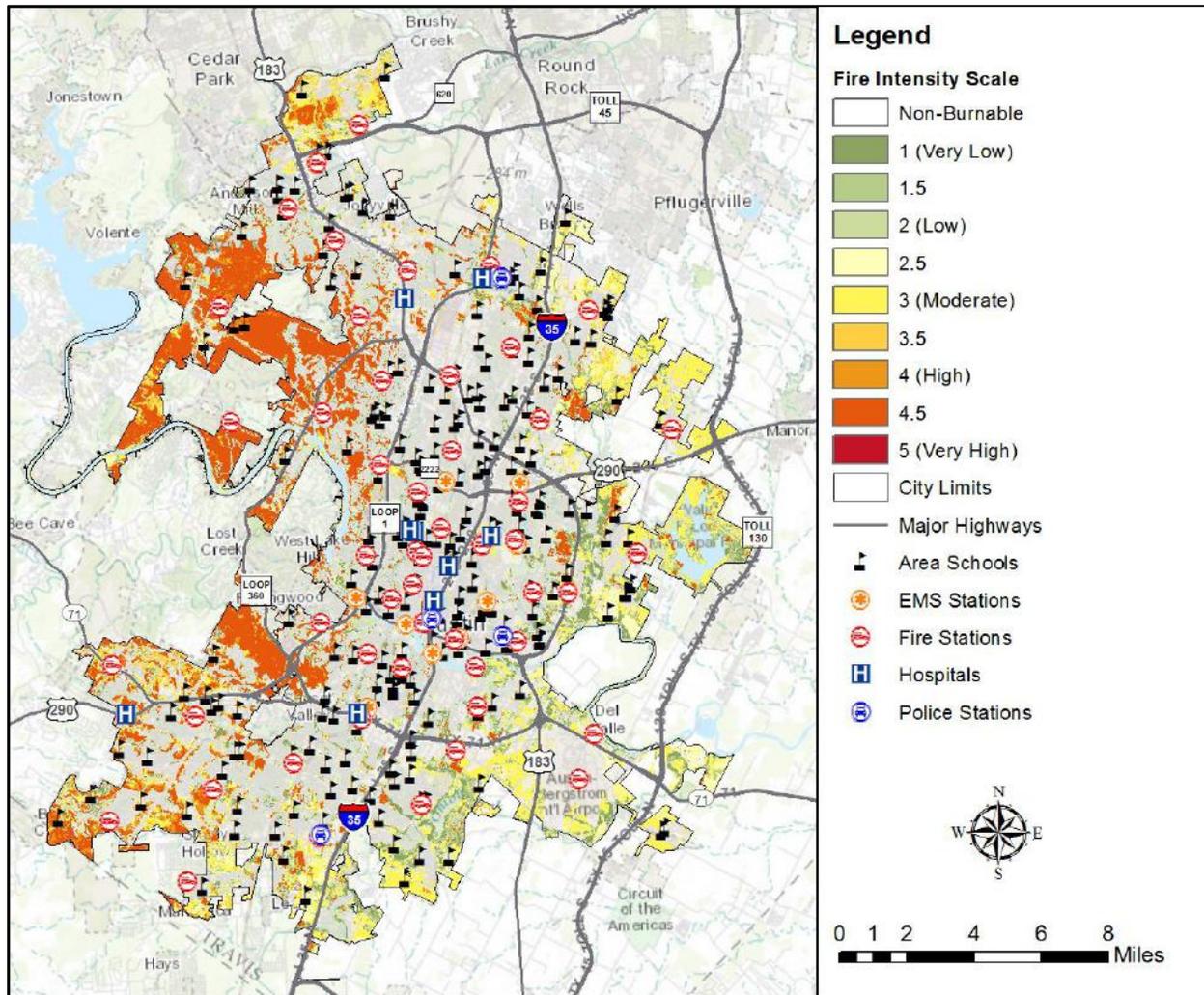
<sup>4</sup> [http://twc.tamu.edu/docs/TFS\\_KBDI\\_Update.pdf](http://twc.tamu.edu/docs/TFS_KBDI_Update.pdf)

## Section 7: Wildfire

The KBDI is a good measure of the readiness of fuels for a wildfire event. The KBDI should be referenced as the area experiences changes in precipitation and soil moisture, and caution should be exercised in dryer, hotter conditions.

The range of intensity for the City of Austin in a wildfire event is within 500 to 600 KBDI. The average extent to be mitigated for the City of Austin planning area is a KBDI of 521. At 521 KBDI, fires will burn readily, exposing mineral soils in some locations. Wildfires may burn or smolder for several days possibly creating smoke and control problems. Figure 7-4 identifies the wildfire intensity for the City of Austin planning area.

**Figure 7-4. Fire Intensity Scale Map – City of Austin and AISD**



### Probability of Future Events

Wildfires can occur at any time of the year. As the City of Austin and AISD both grow and develop more within wild land, the potential area for a wildfire event increases. With 305 events in a ten-year period, an event within the City of Austin and AISD is highly likely and an event is probable within the next year.

### Vulnerability and Impact

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Periods of drought, dry conditions, high temperatures, and low humidity are factors that contribute to the occurrence of a wildfire event. Areas along railroads and people whose homes are in woodland settings have an increased risk of being affected by wildfire.

The heavily populated, urban areas of the City of Austin planning area are not likely to experience large, sweeping fires. Areas outside of the City of Austin, in the unincorporated areas of Travis County, are more vulnerable. Unoccupied buildings and open spaces that have not been maintained have the greatest vulnerability to wildfire. The overall level of concern for wildfires is located mostly along the perimeter of the WUI. Figure 7.1 illustrates the areas that are the most vulnerable to wildfire throughout the city.

Areas along railroads and people with homes in wooded, rural areas have an increased risk of wildfire. Seton Southwest Hospital has a moderate risk to wildfire. The fire and EMS stations that have a low risk to wildfire are: 5309 E. Riverside Dr., 1330 E. Rundberg Ln., 517 S. Pleasant Valley Rd., 11612 Four Irons Dr., 5811 Nuckols Crossing Rd., 5500 Burleson Rd., 6702 Wentworth Dr., 9421 Spectrum Dr., 3704 Deer Ln., 9409 Bluegrass Dr., 4201 Spicewood Springs Rd., 2434 Cardinal Loop, 11205 Harris Branch Pkwy, 7701 River Place Blvd., 2307-A Foster Ave., 5905 Nuckols Crossing Rd., and 2454 Cardinal Loop. The Travis County State Jail has a low risk to wildfire.

Schools with a low risk to wildfire are the following: Allison Elementary, Baty Elementary, Brentwood Christian School, Cooperfield Elementary, Deerpark Middle, Dobie Middle, Dobie PK Center, Harmony School of Excellence, Harmony School of Science – Austin, Harmony Science Academy North Austin, Hart Elementary, John B Connally High, Kipp Austin Vista Middle School, Linder Elementary, Live Oak Elementary, Mendez Middle, Nyos Charter School, River Oaks Elementary, Rodriguez Elementary, The East Austin College Prep Academy, The Real Learning Academy, Texas Neurorehabilitation Center (TNC) Campus, Widen Elementary, Akins High, Austin Discovery School, Bannockburn Christian Academy, Baranoff Elementary, Barton Hills Elementary, Blazier Elementary, Bluebonnet Trail Elementary, Canyon Creek Elementary, Canyon Vista Middle, Country Home Learning Center No. 7, Covington Middle, Cowan Elementary, Cunningham Elementary, Del Valle Elementary, Del Valle Middle, Dessau Middle, Forest North Elementary, Garcia Young Mens Leadership Academy, Hillcrest Elementary, Jordan Elementary, Kipp Austin Academy of Arts & Letters, Kipp Austin College Prep, Kipp Austin Collegiate, Kipp Austin Comunidad, Kipp Austin Connections Elementary, Langford Elementary, Lasa High, Laurel Mountain Elementary, LBJ High School, Oak Meadows Elementary, Overton Elementary, Palm Elementary, Paredes Middle, Patsy Sommer Elementary, Perez Elementary, Pioneer Crossing Elementary, Richards School for Young Women Leaders, Rutledge Elementary, Smith Elementary, and St. Theresa Catholic School Austin.

Five fire and EMS stations in the City of Austin have a moderate risk to wildfire: 8700 W SH 71, 7701 River Place Blvd., 4200 City Park Rd., 11401 Escarpment Blvd, and 3625 Davis Ln. The schools with a moderate risk are: Austin Montessori School, Bowie High, Bridge Point Elementary, Cedar Creek Elementary, Clayton Elementary, Four Points Middle, Gorzycki Middle, Grandview Hills Elementary, Kiker Elementary, Oak Hill Elementary, River Place Elementary, Vandegrift High, Baldwin Elementary, and Regents School of Austin.

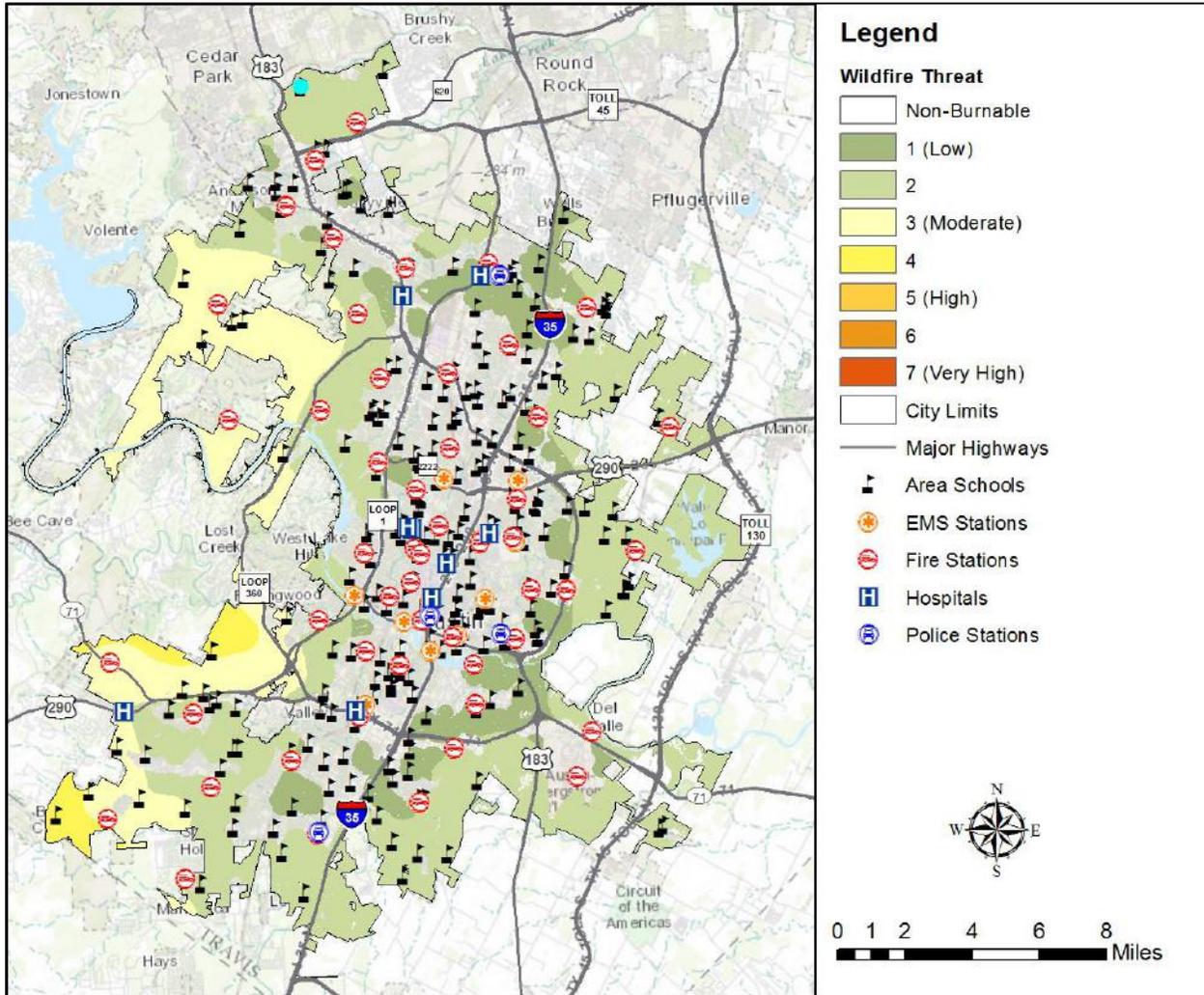
Within the City of Austin planning area, a total of 305 fire events were reported from 2005 to 2015. All of these events were suspected wildfires. Historic loss and annualized loss estimates due to wildfires are presented in Table 7-5. The frequency is approximately 30 events every year. Figure 7-5 illustrates the likelihood of a wildfire event in the City of Austin.

## Section 7: Wildfire

**Table 7-5. Historic Loss Estimates Due to Wildfire<sup>5</sup>**

JURISDICTION	NUMBER OF EVENTS	ACRES BURNED	INJURIES	DEATHS	ANNUAL LOSSES	ANNUAL ACRE LOSSES
City of Austin	305	475.2	0	0	\$1,246,775	70

**Figure 7-5. Likelihood of Wildfire Starting – City of Austin and AISD**



Diminished air quality is an environmental impact that can result from a wildfire event and pose a potential health risk. The smoke plumes from wildfires can contain potentially inhalable carcinogenic matter. Fine particles of invisible soot and ash that are too microscopic for the respiratory system to filter can cause immediate and possibly long term health effects. The elderly or those individuals with compromised respiratory systems may be more vulnerable to the effects of diminished air quality after a wildfire event.

<sup>5</sup> Events divided by 10 years of data.

## Section 7: Wildfire

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Climatic conditions such as severe freezes and drought can significantly increase the intensity of wildfires since these conditions kill vegetation, creating a prime fuel source for wildfires. The intensity and rate at which wildfires spread are directly related to wind speed, temperature, and relative humidity.

A wildfire event poses a potentially significant risk to public health and safety, particularly if the wildfire is initially unnoticed and spreads quickly. The risk for injury or death from the variety of threats during a wildfire are present to persons in the area at the time of the fire, with the foremost threats being burns to the human body and smoke inhalation.

Response personnel face the same potential impacts as the general public. Due to the nature of their responsibilities that may bring them closer to the hazard, response personnel can also be at increased risk of physical injury. Prolonged exposure to smoke, chemicals, and heat may result in more long-term impacts for response personnel. Heart disease, respiratory problems, and related illnesses can develop in response personnel after repeated and concentrated exposure.

Depending on the characteristics and location of the wildfire event, it is possible that operations and service delivery could be impacted by a wildfire. Roadways in or near the WUI could also be impacted by wildfire. Damage may occur from the wildfire, or closures could result from limited visibility due to heavy smoke in the area.

Damage from a wildfire can have an impact on utility infrastructure. This could result in a temporary loss of function for businesses in the City of Austin planning area that rely on utilities for operation, even if those businesses were not directly impacted by the fire. Additionally, businesses can suffer interruption from closed or blocked roadways. For example, firefighters may need to close a roadway in the event that a wildfire grows out of control or shifts unexpectedly. This could negatively impact other businesses in the area that were not otherwise damaged.

Wildfires are often a natural phenomenon and part of the normal cycle of the natural environment. In fire-dependent ecosystems, many plants and animals cannot survive without the cycles of fire to which they are adapted. If all fire is suppressed, fuel may build up, making hotter, more destructive fires inevitable which can result in significant deforestation, wildlife death, and cause water and air pollution. Environmental damage caused by a wildfire event may take decades, or longer, to become fully restored.

Wildfire also performs a variety of environmentally beneficial functions to the burned area if they are low in intensity and do not grow out of control. Fire removes low-growing underbrush, opens the area to sunlight, and nourishes the soil. Reducing the competition for nutrients allows established trees to grow stronger and healthier. Through the clearing of heavy brush, new grasses, herbs, and regenerated shrubs are able to grow, providing food and habitat for many wildlife species. Small seed-eating mammals and birds are attracted to the area, which in turn attracts predators like foxes, hawks, and weasels. Cavity nesting birds, such as flickers, chickadees, and woodpeckers, thrive on the insects that inhabit fire-killed trees.

The Austin planning area is home to a large number of cultural and historic resources. Many of the historic neighborhoods may be at risk from a wildfire event because they are of a construction type and material that is more vulnerable to fire. Historic homes are often constructed close together and are generally exempt from modern building code requirements, which may require fire suppression equipment in the structure. Additionally, the City's historic and cultural resources are a significant draw for tourists and visitors to the area and help to generate revenue through taxes and fees. This revenue in turn pays services and programs, which benefit residents and the community.

## Section 7: Wildfire

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The financial and economic impacts associated with a wildfire event may be significant. A major fire, where a large number of structures are damaged or destroyed, can have serious economic and financial consequences for a community. These consequences will depend on what is damaged, the extent of the damage, and the services the damaged structures provided to the community.

The severity of impact from major wildfire events can be substantial. Such events can cause multiple deaths, shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage. Severity of impact is gauged by acreage burned, homes and structures lost, and the number of resulting injuries and fatalities. For the City of Austin and AISD, the impact from a wildfire event can be considered "Minor," and injuries are possible but may not result in permanent disability, complete shutdown of critical area facilities for more than one week, and more than ten percent of property destroyed or with major damage.

# Section 8: Extreme Heat

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## Hazard Description

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Extreme heat is the condition whereby temperatures hover ten degrees or more above the average high temperature in a region for an extended period. Extreme heat during the summer months is a common occurrence throughout the State of Texas, and the City of Austin. Severe, excessive summer heat is characterized by a combination of exceptionally high temperatures and humidity. When these conditions persist over a period of time, it is defined as a heat wave. The City of Austin typically experiences extended heat waves.



Although heat can damage buildings and facilities, it presents a more significant threat to the safety and welfare of citizens and animals. The major human risks associated with severe summer heat include: heat cramps; sunburn; dehydration; fatigue; heat exhaustion; and even heat stroke. The most vulnerable population to heat casualties are children and the elderly or infirmed, who frequently live on low fixed incomes and cannot afford to run air-conditioning on a regular basis. This population is sometimes isolated, with no immediate family or friends to look out for their well-being.

## Location

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Though injuries and deaths from extreme heat have been recorded in Travis County, there is no specific geographic scope to the extreme heat hazard. Extreme heat could occur in any area of the City of Austin and the Austin Independent School District (AISD).

## Extent

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The magnitude or intensity of an extreme heat event is measured according to temperature in relation to the percentage of humidity. According to the National Oceanic and Atmospheric Administration (NOAA), this relationship is referred to as the “Heat Index,” and is depicted in Figure 8-1. The Heat Index measures how hot it feels outside when humidity is combined with high temperatures.

## Section 8: Extreme Heat

**Figure 8-1. Extent Scale for Extreme Summer Heat<sup>1</sup>**

Temperatures (°F)		Temperatures (°F)		Temperatures (°F)		Temperatures (°F)	
40	80 - 88: CAUTION	40	90 - 96: EXTREME CAUTION	40	98 - 106: DANGER	40	108 - 110: EXTREME DANGER
45	80 - 88: CAUTION	45	90 - 94: EXTREME CAUTION	45	96 - 104: DANGER	45	106 - 110: EXTREME DANGER
50	80 - 86: CAUTION	50	88 - 94: EXTREME CAUTION	50	96 - 102: DANGER	50	104 - 110: EXTREME DANGER
55	80 - 86: CAUTION	55	88 - 92: EXTREME CAUTION	55	94 - 100: DANGER	55	102 - 110: EXTREME DANGER
60	80 - 84: CAUTION	60	86 - 90: EXTREME CAUTION	60	92 - 98: DANGER	60	100 - 110: EXTREME DANGER
65	80 - 84: CAUTION	65	86 - 90: EXTREME CAUTION	65	92 - 96: DANGER	65	98 - 110: EXTREME DANGER
70	80 - 84: CAUTION	70	86 - 88: EXTREME CAUTION	70	90 - 94: DANGER	70	96 - 110: EXTREME DANGER
75	80 - 82: CAUTION	75	84 - 88: EXTREME CAUTION	75	90 - 94: DANGER	75	96 - 110: EXTREME DANGER
80	80 - 82: CAUTION	80	84 - 86: EXTREME CAUTION	80	88 - 92: DANGER	80	94 - 110: EXTREME DANGER
85	80 - 82: CAUTION	85	84 - 86: EXTREME CAUTION	85	88 - 90: DANGER	85	92 - 110: EXTREME DANGER
90	80: CAUTION	90	82 - 84: EXTREME CAUTION	90	86 - 90: DANGER	90	92 - 110: EXTREME DANGER
95	80: CAUTION	95	82 - 84: EXTREME CAUTION	95	86 - 88: DANGER	95	90 - 110: EXTREME DANGER
100	80: CAUTION	100	82 - 84: EXTREME CAUTION	100	86 - 88: DANGER	100	90 - 110: EXTREME DANGER

**Likelihood of Heat Disorders with  
Prolonged Exposure or Strenuous Activity**

The extent scale in Figure 8-1 displays varying degrees of caution depending on the relative humidity combined with the temperature. For example, when the temperature is at 90 degrees Fahrenheit (°F) or lower, caution should be exercised if the humidity level is at or above 40 percent.

The shaded zones on the chart indicate varying symptoms or disorders that could occur depending on the magnitude or intensity of the event. “Caution,” is the first level of intensity where fatigue due to heat exposure is possible. “Extreme Caution,” indicates that sunstroke, muscle cramps or heat exhaustion are possible, and a “Danger” level means that these symptoms are likely. “Extreme Danger,” indicates that heat stroke is likely. The National Weather Service (NWS) initiates alerts based on the Heat Index as shown in Table 8-1.

<sup>1</sup> Source: NOAA

## Section 8: Extreme Heat

**Table 8-1. Heat Index & Warnings<sup>2</sup>**

CATEGORY	HEAT INDEX	POSSIBLE HEAT DISORDERS	WARNING
Extreme Danger	130° F and higher	Heat stroke or sun stroke likely.	A heat advisory will be issued to warn that the Heat Index may exceed 105° F.
Danger	105 – 129° F	Sunstroke, muscle cramps, and/or heat exhaustion are likely. Heatstroke possible with prolonged exposure and/or physical activity.	
Extreme Caution	90 – 105° F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.	An Excessive Heat Warning is issued if the Heat Index is expected to be 105° F or higher for at least 2 days and will not drop below 75° F at night.
Caution	80 – 90° F	Fatigue is possible with prolonged exposure and/or physical activity.	

Due to its location, and its urban makeup, the City of Austin, including the AISD, can expect an extreme heat event each summer. The City of Austin created an Emergency Operations Heat Plan in 2011 after the Heat Wave of 2009. The Heat Plan is triggered when the National Weather Service issues advisories or warnings for excessive heat above 105° F for more than three hours per day, and two days in a row. Emergency visits and calls due to heat-related illness is monitored by the Austin/Travis County Health and Human Services Department and reported to the City of Austin.

Citizens, especially children and the elderly, should exercise caution by staying out of the heat for prolonged periods when a heat advisory or excessive heat warning is issued. Also at risk are those working or remaining outdoors for prolonged periods of time. Due to the abundance of concrete and metal infrastructure, the effects of an extreme heat event can be intensified. Concrete and metal absorb heat energy and emit that energy at night, thereby trapping heat, and causing the temperature to feel as much as 10 degrees higher than surrounding areas. This is known as the “heat island” effect.

Daytime temperatures in summer are hot, with highs over 90 degrees about 80 percent or more of the time. Cool fronts may affect the area and drop overnight lows to the 50s on some occasions. In these cases, warm winds quickly return, pushing lows to the 70s in a few days. In very hot summers, the continental regime of West and North Texas can have an impact of keeping daytime highs near and above 100 degrees, especially with hot west and southwest winds. Most of the time, the moderating effects of the Gulf of Mexico limit daytime highs; however, they also add to the discomfort with higher humidity. Sometimes, when weak fronts that have lost most of their cool air properties and move through the area, warmer than normal daytime highs follow, as the area is blocked from the moderating effects of the Gulf of Mexico.<sup>3</sup>

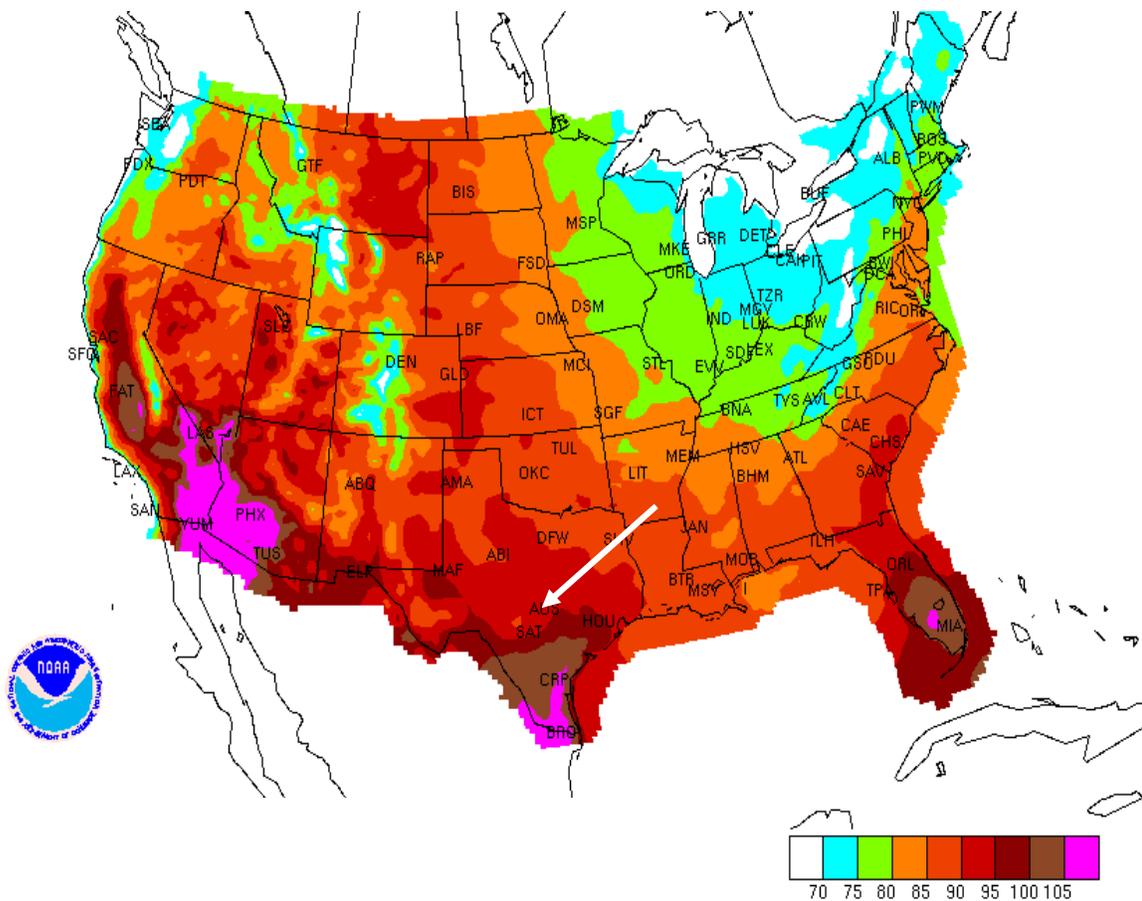
<sup>2</sup> <http://www.nws.noaa.gov/om/heat/ww.shtml>

<sup>3</sup> <http://www.srh.noaa.gov/images/ewx/climate/ausclisum.pdf>

## Section 8: Extreme Heat

Figure 8-2 displays the daily maximum heat index as derived from NOAA based on data compiled from 1849 to 2014. The City of Austin and AISD has an average daily maximum heat index of 90-95 degrees F. Using the Heat Index, the City of Austin and AISD falls within the “Caution” to “Danger” category, meaning the average extent to mitigate for citizens in the planning area is sunstroke, muscle cramps, and heat exhaustion.

**Figure 8-2. Average Daily Maximum Heat Index<sup>4</sup>**



## Historical Occurrences

Every summer, the hazard of heat-related illness becomes a significant public health issue throughout much of the US. Mortality from all causes increases during heat waves, and excessive heat is an important contributing factor to deaths from other causes, particularly among the elderly. Data from the Texas Department of State Health Services suggest that between 2003 and 2008, record high summer temperatures in Texas resulted in 439 heat-related deaths statewide. The highest temperature of record at Camp Mabry, located in the City of Austin, was 112 degrees F on September 5, 2000 and August 28, 2011. The highest temperature of record at Austin Bergstrom International

<sup>4</sup> Source: NOAA and the white arrow points to the City of Austin.

## Section 8: Extreme Heat

Airport was 112 degrees F on September 5, 2000.<sup>5</sup> Table 8-2 depicts historical occurrences of mortality due to heat from 2008 to 2014 provided by the Austin/Travis County Health and Human Services Department.

**Table 8-2. Extreme Heat Related Deaths in Austin**

YEAR	DEATHS
2008	3
2009	1
2010	1
2011	5
2012	0
2013	5
2014	2

According to heat related incidents located solely within Travis County there are 12 heat waves<sup>6</sup> on record. Historical extreme heat information, as provided by the NCDC and SHELDUS, shows extreme heat activity across a multi-county forecast area for each event, the appropriate percentage of the total property and crop damage reported for the entire forecast area has been allocated to each county impacted by the event. It is important to note historical extreme heat data for the City of Austin and AISD is provided on a County-wide basis per the NCDC and SHELDUS databases; with all of the AISD schools and facilities being located within Travis County, the data is provided in Table 8-3 below. Only extreme heat events that have been reported have been factored into this Risk Assessment. It is likely that additional extreme heat occurrences have gone unreported before and during the recording period. Table 8-3 shows historical incident information for Travis County which resulted in death, property, or crop damage between 1950 and November 2014.

**Table 8-3. Historical Extreme Heat, 1950-2014**

JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Travis County	7/1/1980	3	1	\$5,319	\$531,915	\$15,086	\$1,508,644
Travis County	7/29/1999	1	0	\$0	\$0	\$0	\$0
Travis County	8/14/1999	1	0	\$0	\$0	\$0	\$0

<sup>5</sup> <http://www.srh.noaa.gov/images/ewx/climate/ausclisum.pdf>

<sup>6</sup> Even though the City experiences heat waves each summer, NCDC and SHELDUS data only records events reported. Based on reports, only 12 events are on record.

## Section 8: Extreme Heat

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JURISDICTION	DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
Travis County	8/16/1999	1	0	\$0	\$0	\$0	\$0
Travis County	7/4/2000	1	0	\$0	\$0	\$0	\$0
Travis County	7/5/2000	1	0	\$0	\$0	\$0	\$0
Travis County	7/18/2000	1	0	\$0	\$0	\$0	\$0
Travis County	7/23/2000	1	0	\$0	\$0	\$0	\$0
Travis County	7/23/2000	1	0	\$0	\$0	\$0	\$0
Travis County	8/9/2011	1	0	\$0	\$0	\$0	\$0

### Significant Past Events

#### June 15, 2009

A heat related death occurred in Austin. A water well drilling construction worker was found unresponsive in his vehicle in South Austin in the late afternoon. He had been working outside for several days during the heat wave. He died from heat exhaustion.<sup>7</sup>

#### Summer of 2011

The summer of 2011 marked a period of extreme heat for the City. Temperatures across South Central Texas rose in advance of a cold front in May. The high in Austin was 100 degrees F. A one year old girl was found unresponsive in a parked vehicle in northwest Austin and was taken to a hospital where she was pronounced dead. Again in August, persistent high pressure over Austin led to record high temperatures during a heat wave. A man died along County Line Road in Elgin due to hyperthermia. The high temperature at Austin Bergstrom International Airport reached 103 degrees and the heat index topped out at 109. This was the 11<sup>th</sup> consecutive day the temperature reached 100 degrees.

#### June 5, 2012

An Austin highway construction worker died due to heat stress.<sup>8</sup>

#### July 8 & July 14, 2014

Austin/Travis County Health & Human Services Department reported two deaths due to hyperthermia.

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<sup>7</sup> [https://www.osha.gov/SLTC/heatillness/map\\_text.html](https://www.osha.gov/SLTC/heatillness/map_text.html)

<sup>8</sup> Ibid

### Probability of Future Events

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According to historical records, Travis County, including the City of Austin and AISD, experiences an extreme heat event every year. Hence, the likelihood or future probability of an excessive summer heat event in the City of Austin and AISD is highly likely.

### Vulnerability and Impact

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Because extreme heat events are not confined to specific geographic boundaries, all existing and future buildings, facilities, and populations are considered to be exposed to this hazard and could potentially be impacted.

Although heat can damage buildings and facilities, it presents a more significant threat to the safety and welfare of citizens, particularly the elderly population or the infirm that live within the City of Austin planning area and cannot afford air conditioning or to run it on a regular basis. Students attending in the AISD are also susceptible as sporting events and practices are often held outside during early fall or late spring when temperatures are at the highest. The major human risks associated with severe summer heat include: heat cramps; sunburn; dehydration; fatigue; heat exhaustion; and even heat stroke. Also area mobile home housing may not be equipped to cool residents. These individuals may need a place to go during the hottest daytime hours. Additionally, livestock and crops can become stressed, decreasing in quality or in production, during times of extreme heat, causing food prices to escalate.

Extreme high temperatures can have significant secondary impacts, leading to droughts, water shortages, increased fire danger, and prompt excessive demands for energy. The economic and financial impacts of extreme heat on the City of Austin and AISD will depend on the duration of the event, demand for energy, drought associated with extreme heat, and many other factors. The possibility of rolling blackouts increases with unseasonably high temperatures in what is a normally mild month with low power demands.

If extreme heat is combined with a drought, the environment can be affected, with potential habitat damage both for aquatic and terrestrial species. Fisheries can be negatively impacted by extreme heat, as rising water temperatures contribute to the degradation of water quality, leading to the death of many fish and other organisms in the water ecosystem. Heat stress affects animals both directly and indirectly. Overtime, heat stress can increase vulnerability to disease, reduce fertility, and reduce milk production. Drought may also threaten pasture and feed supplies, as the amount of quality forage available to grazing livestock is reduced. High temperatures at key development stages of growth can significantly inhibit a crop yield.

The change in crop production not only affects the animals that rely on grain, but also food supply as a whole. Food suppliers can anticipate an increase in food costs due to increases in production costs along with crop and livestock losses. All of these issues lead to a potential reduction in income for these sectors of the economy, which can have an overall negative impact on the economy.

The demand for water increases during period of extreme heat, causing reduced water supply and pressure in many areas. Water suppliers may experience dramatic revenue shortfalls or windfall profits depending on their level of advance planning for such conditions. For suppliers that did not plan accordingly, increased costs can result from the need for water transport/transfer and/or new/supplemental water resource development. A reduction in the water supply may also contribute to fire suppression problems for fire departments.

## Section 8: Extreme Heat

Air quality impacts are also associated with rising temperatures. Ground-level ozone (or “smog”) is formed when hydrocarbon and nitrogen oxide pollution from vehicles, power plants, and other combustion combines in sunlight and heat.<sup>9</sup> Extreme heat will contribute to more ozone in the air, which provides a real health threat, especially for children, the elderly and those with respiratory problems.

Infrastructure in Central Texas is generally designed to withstand relatively high temperatures. However, extreme heat can contribute to accelerated pavement deterioration, thermal misalignments in rail lines, and can affect maintenance and construction crews. In addition to having physical impacts on assets, extreme temperatures can affect operations and maintenance across modes of transportation. Temperatures above 100 degrees F create a health and safety hazard for maintenance and construction crews. When temperatures reach 105 degrees F, employees must take 10-minute hydration breaks every 50 minutes. Rail lines in the City of Austin planning area are set with a rail-neutral temperature between 100 degrees F and 115 degrees F, after which the risk of thermal misalignment increases. Thermal misalignments, in turn, can increase the risk of train derailments and cause operational disruptions and slower operating speeds. Thermal misalignments on Capital Metro rail have occurred in the past, but the agency issues precautionary speed restrictions during high heat days to reduce the risk of derailments. Freight lines have lower thresholds for speed restrictions than passenger lines.<sup>10</sup>

Impact of extreme heat experienced in the City of Austin, including AISD, has a major severity as injuries and illnesses can result in permanent disability; although in terms of structures, the City of Austin and AISD is considered to have a limited severity of impact meaning shutdown of facilities and services for 24 hours or less, and less than ten percent of property is destroyed or with major damage.

Loss estimates were based on 64 years of statistical data from the NCDC and SHELDUS. An extreme heat event frequency-impact was then developed to determine an impact profile on estimated potential losses due to extreme heat in the area. Only extreme heat events that have been reported have been factored into this Risk Assessment. It is likely that additional extreme heat occurrences have gone unreported before and during the recording period. Table 8-4 shows the annualized losses based on historical incident information for the planning area which resulted in property or crop damage. The average annualized loss is approximately \$44,816 per year.

**Table 8-4. Extreme Heat Event Damage Totals, 1950-2014**

JURISDICTION	NUMBER OF EVENTS	PROPERTY DAMAGES	CROP DAMAGES	PROPERTY DAMAGES (2015 DOLLARS)	CROP DAMAGES (2015 DOLLARS)
Travis County	12	\$5,319	\$531,915	\$15,086	\$1,508,644
<b>TOTAL LOSSES:</b>		<b>\$537,234</b>		<b>\$1,523,730</b>	

<sup>9</sup> Source: *Time Magazine* Science and Space, Weather: “Why Bad Heat = Bad Air”

<sup>10</sup> Source: Central Texas Extreme Weather & Climate Change Vulnerability Assessment of Regional Transportation Infrastructure

# Section 9: Thunderstorm Wind

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## Hazard Description

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Thunderstorms create extreme wind events which includes straight line winds. Wind, is the horizontal motion of the air past a given point, beginning with differences in air pressures. Pressure that is higher at one place than another sets up a force pushing from the high toward the low pressure; the greater the difference in pressures, the stronger the force. The distance between the area of high pressure and the area of low pressure also determines how fast the moving air is accelerated.



Thunderstorms are created when heat and moisture near the Earth's surface are transported to the upper levels of the atmosphere. By-products of this process are the clouds, precipitation, and wind that become the thunderstorm. Sub-hazards of thunderstorms are hail and tornadoes, which are profiled separately in this Plan Update.

According to the National Weather Service (NWS), a thunderstorm occurs when thunder accompanies rainfall. Radar observers use the intensity of radar echoes to distinguish between rain showers and thunderstorms.

Straight line winds are responsible for most thunderstorm wind damages. One type of straight line wind, the downburst, is a small area of rapidly descending air beneath a thunderstorm. A downburst can cause damage equivalent to a strong tornado and make air travel extremely hazardous.

Straight line winds can have gusts of 100 mph or more, and are often accompanied by hail or rain. Unlike tornadoes, windstorms have a broader path that is several miles wide and can cover several counties. Straight line wind may down trees and power lines, overturn mobile homes, and cause damage to well-built structures.

## Location

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Severe thunderstorm winds are generally considered a common occurrence in the City of Austin. Typical thunderstorms are 15 miles in diameter and lasts an average of 30 minutes. Despite the short time span, thunderstorms can be extremely dangerous as they are often strong and fast in their approach and can be accompanied by flash flooding, hail, tornadoes, and high winds.

## Section 9: Thunderstorm Wind

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Thunderstorms occur randomly, and therefore it is impossible to predict where they will strike within the City of Austin. Thus, it is assumed that the City of Austin, including the Austin Independent School District (AISD), is uniformly exposed to the threat of thunderstorm winds.

### Extent

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The extent or magnitude of a thunderstorm wind event is measured by the Beaufort Wind Scale. Table 9-1 describes the different intensities of wind in terms of speed and effects, from calm to violent and destructive.

**Table 9-1. Beaufort Wind Scale<sup>1</sup>**

FORCE	WIND (KNOTS)	WMO CLASSIFICATION	APPEARANCE OF WIND EFFECTS
0	Less than 1	Calm	Calm, smoke rises vertically
1	1-3	Light Air	Smoke drift indicates wind direction, still wind vanes
2	4-7	Light Breeze	Wind felt on face, leaves rustle, vanes begin to move
3	8-12	Gentle Breeze	Leaves and small twigs constantly moving, light flags extended
4	13-18	Moderate Breeze	Dust, leaves and loose paper lifted, small tree branches move
5	19-24	Fresh Breeze	Small trees in leaf begin to sway
6	25-31	Strong Breeze	Larger tree branches moving, whistling in wires
7	32-38	Near Gale	Whole trees moving, resistance felt walking against wind
8	39-46	Gale	Whole trees in motion, resistance felt walking against wind
9	47-54	Strong Gale	Slight structural damage occurs, slate blows off roofs
10	55-63	Storm	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	64-72	Violent Storm	If experienced on land, widespread damage
12	73+	Hurricane	Violence and destruction

On average, the planning area experiences two to three thunderstorm wind events every year. According to the available data for previous occurrences, high winds are common to the planning area when accompanied by thunderstorms. The City of Austin, including the AISD, has experienced a significant wind event, or an event with winds in the range of "Force 10" on the Beaufort Wind Scale, with the average measurement of severe winds with a thunderstorm having winds at 55-63 knots.

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<sup>1</sup> Source: World Meteorological Organization

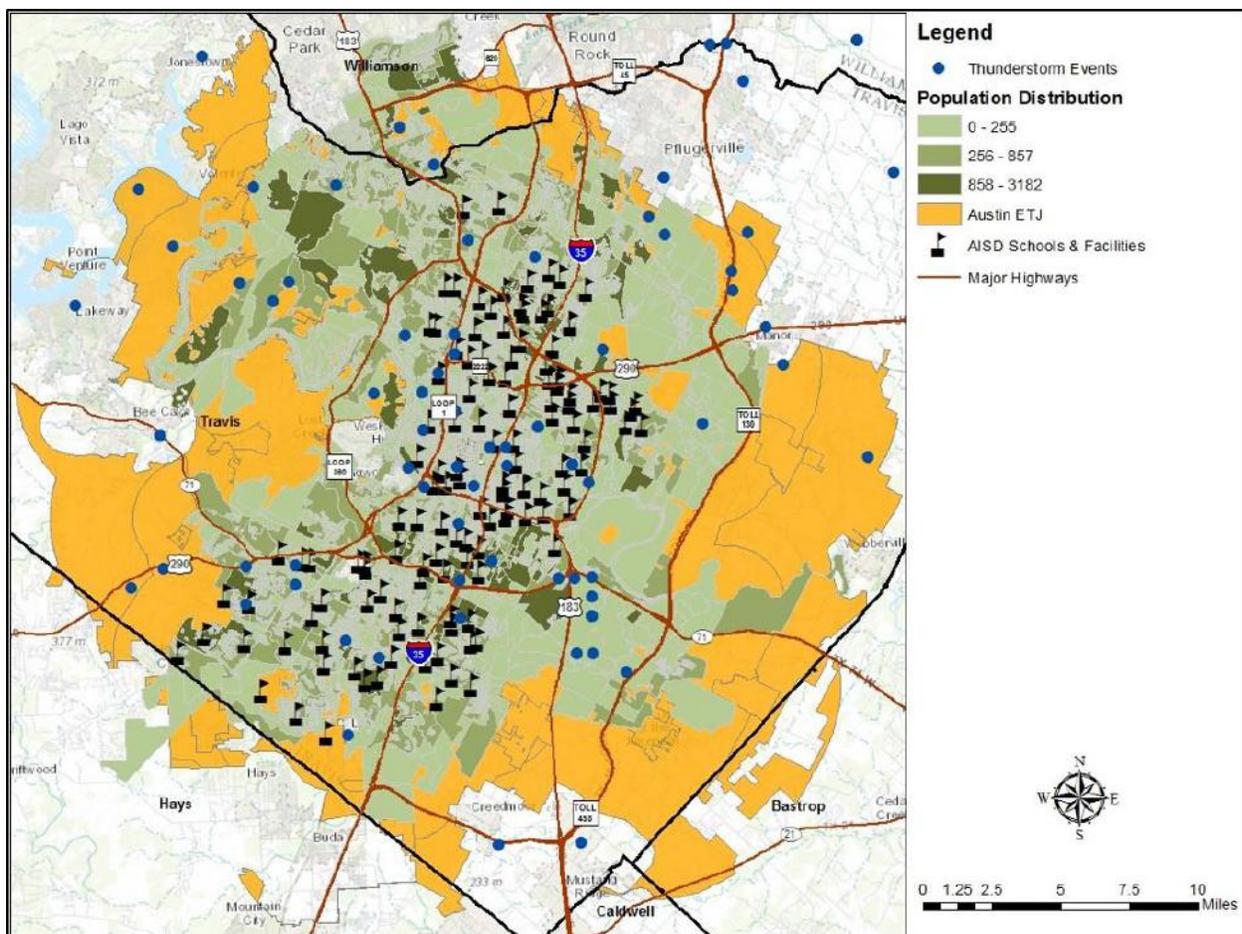
## Section 9: Thunderstorm Wind

Therefore, the planning area on average could experience a range of wind speeds where whole trees are broken or uprooted.

### Historical Occurrences

Figure 9-1 shows the locations of previous occurrences in the City of Austin planning area from 1955 to 2014. Tables 9-2 and 9-3 on the following page lists historical occurrences of thunderstorm events for the City of Austin planning area according to the National Climatic Data Center (NCDC) data. Since January 1955, 211 severe thunderstorm events are known to have impacted Travis County, based upon NCDC and Spatial Hazard Events & Losses Database for the United States (SHELDUS) records. The table presents information on 135 of those historical events known to have specifically impacted the City of Austin planning area. It is important to note that high wind events associated with other hazards, such as tornadoes, are not accounted for in this section.

**Figure 9-1. Spatial Historical Thunderstorm Wind Events, 1955–2014<sup>2</sup>**



Only thunderstorm events that have been reported have been factored into this Risk Assessment. It is likely that additional thunderstorm occurrences have gone unreported before and during the

<sup>2</sup> Source: NOAA Records

## Section 9: Thunderstorm Wind

recording period. Table 9-2 shows historical incident information for the planning area which resulted in property or crop damage from 1955 to November 2014.

**Table 9-2. Historical Thunderstorm Wind Events, 1955-2014**

DATE	TIME	MAGNITUDE (knots)	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
5/25/1961	2:11 PM	52	\$0	\$0	\$0	\$0
5/29/1962	1:00 AM	62	\$0	\$0	\$0	\$0
5/16/1965	2:18 PM	0	\$5,000	\$0	\$37,096	\$0
3/12/1971	7:00 PM	0	\$125,000	\$0	\$721,318	\$0
1/20/1973	8:15 PM	0	\$500	\$0	\$2,632	\$0
5/23/1975	6:00 PM	69	\$625,000	\$62,500	\$2,714,998	\$271,500
2/17/1976	11:15 AM	65	\$500,000	\$0	\$2,053,664	\$0
3/30/1976	3:40 AM	0	\$8,333	\$833	\$34,228	\$34,228
8/26/1976	4:40 PM	0	\$5,000	\$0	\$20,537	\$0
2/29/1980	8:30 PM	50	\$50,000	\$0	\$141,813	\$0
5/13/1980	12:00 PM	0	\$55,000	\$10,000	\$155,994	\$28,363
7/28/1980	1:38 PM	60	\$50,000	\$0	\$141,813	\$0
8/22/1980	4:00 PM	0	\$50,000	\$0	\$141,813	\$0
10/16/1980	12:00 AM	0	\$50,000	\$0	\$141,813	\$0
5/24/1981	10:07 PM	50	\$5,000	\$0	\$12,855	\$0
9/3/1981	4:20 PM	0	\$5,000	\$0	\$12,855	\$0
4/20/1982	8:25 AM	65	\$50,000	\$500	\$121,092	\$1,211
5/12/1982	12:55 AM	65	\$200,000	\$0	\$484,367	\$0
5/13/1982	7:10 AM	0	\$5,000	\$0	\$12,109	\$0
6/22/1982	5:39 PM	0	\$50,000	\$0	\$121,092	\$0
7/18/1984	12:18 PM	54	\$5,000	\$0	\$11,247	\$0
5/30/1993	6:59 PM	51	\$0	\$5,000	\$0	\$8,087
10/19/1993	11:25 PM	0	\$5,000	\$5,000	\$8,087	\$8,087

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DATE	TIME	MAGNITUDE (knots)	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
5/29/1994	10:52 PM	53	\$50,000	\$5,000	\$78,849	\$7,885
11/4/1994	11:55 PM	57	\$5,000	\$0	\$7,884.85	\$0
6/11/1995	1:26 AM	65	\$10,000	\$10,000	\$15,335	\$15,335
9/7/1995	8:00 PM	0	\$3,100,000	\$0	\$4,753,883	\$0
9/20/1996	8:55 PM	0	\$20,000	\$0	\$29,791	\$0
4/4/1997	6:30 PM	0	\$200,000	\$0	\$291,224	\$0
3/7/1998	5:50 PM	0	\$150,000	\$0	\$215,068	\$0
4/26/1998	7:50 PM	0	\$80,000	\$0	\$114,703	\$0
5/24/1999	8:30 PM	0	\$50,000	\$0	\$70,140	\$0
5/26/1999	5:25 PM	0	\$70,000	\$0	\$98,196	\$0
4/11/2000	11:42 PM	51	\$20,000	\$0	\$27,144	\$0
3/12/2001	1:30 AM	0	\$150,000	\$0	\$197,945	\$0
9/3/2001	8:05 PM	0	\$50,000	\$0	\$65,982	\$0
6/16/2002	2:00 AM	0	\$50,000	\$0	\$64,955	\$0
6/26/2002	7:20 PM	0	\$100,000	\$0	\$129,909	\$0
12/23/2002	6:25 AM	0	\$10,000	\$0	\$12,991	\$0
6/13/2003	3:45 PM	56	\$100,000	\$0	\$127,015	\$0
8/8/2003	3:23 PM	57	\$100,000	\$0	\$127,015	\$0
8/11/2003	7:05 PM	60	\$600,000	\$0	\$762,088	\$0
6/28/2004	4:40 PM	60	\$20,000	\$0	\$24,744	\$0
5/4/2006	9:30 PM	64	\$100,000	\$0	\$115,926	\$0
10/10/2006	6:17 AM	55	\$100,000	\$0	\$115,926	\$0
4/13/2007	8:30 PM	55	\$50,000	\$0	\$56,358	\$0
5/14/2008	11:30 PM	70	\$50,000,000	\$0	\$54,273,976	\$0
6/21/2008	1:00 PM	50	\$5,000	\$0	\$5,427	\$0
3/25/2009	4:45 PM	39	\$50,000	\$0	\$54,468	\$0

## Section 9: Thunderstorm Wind

DATE	TIME	MAGNITUDE (knots)	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
4/2/2009	10:29 AM	45	\$10,000	\$0	\$10,894	\$0
4/2/2009	1:07 PM	45	\$10,000	\$0	\$10,894	\$0
4/2/2009	1:37 PM	40	\$10,000	\$0	\$10,894	\$0
4/2/2009	1:55 PM	39	\$10,000	\$0	\$10,894	\$0
4/2/2009	2:17 PM	40	\$10,000	\$0	\$10,894	\$0
8/12/2009	2:55 PM	50	\$2,000	\$0	\$2,179	\$0
8/26/2009	7:32 PM	52	\$2,000	\$0	\$2,179	\$0
8/27/2009	4:40 PM	50	\$10,000	\$0	\$10,894	\$0
5/20/2011	7:10 PM	40	\$1,000	\$0	\$1,039	\$0
7/15/2012	4:25 PM	50	\$15,000	\$0	\$15,269	\$0
4/7/2014	6:35 PM	48	\$2,000	\$0	\$1,974	\$0
5/26/2014	11:00 AM	35	\$1,000	\$0	\$987	\$0

Based on the list of historical thunderstorm wind events for the City of Austin (listed above), 27 of the events occurred after the 2010 Plan Update. These events are from the date of June 2008 through November 2014. It is important to note that the AISD schools and facilities are all located within the City of Austin planning area. There may be some occurrences that have occurred for the AISD and may not have been recorded, but are included in the City of Austin occurrence data because of their location. Only thunderstorm events that have been reported have been factored into this Risk Assessment. It is likely that additional thunderstorm occurrences have gone unreported before and during the recording period. Table 9-3 shows the annualized losses based on historical incident information for the planning area which resulted in death, injury, property or crop damage.

**Table 9-3. Summary of Historical Thunderstorm Wind Events, 1955-2014**

EVENTS	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
135 events	55 knots	5	18	\$69,017,348	\$374,694
	(max extent)				

## Section 9: Thunderstorm Wind

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### Significant Past Events

#### **June 12, 2014 – City of Austin**

An upper level low and surface cold front moved through South Central Texas producing thunderstorms. These storms produced a few tornadoes and damaging wind gusts across many areas of South Central Texas. The thunderstorm produced wind gusts estimated at 60 mph that tore five inch diameter branches off of some Lace Bark Elms.

#### **July 15, 2012 – City of Austin**

A stagnant upper air pattern of a weak trough combined with deep subtropical moisture to cause thunderstorms for several days. These storms produced isolated areas of heavy rain leading to flash flooding along with some strong winds and large hail. A thunderstorm produced wind gusts estimated at 58 mph that flipped over six boats at the Emerald Point Marina on Lake Travis.

#### **May 12, 2011 – AISD**

AISD reported that the thunderstorm wind event that occurred on May 12, 2011 affected all southwestern AISD schools, with wind speeds up to 52 knots.

#### **May 14, 2008 – City of Austin**

A severe thunderstorm to the southwest of the City of Austin moved northeast across the downtown area causing extensive damage from winds and large hail. Widespread damage occurred over portions of central Austin when a large severe thunderstorm rolled through the downtown area. Numerous reports of large trees and branches were down along with wind-blown hail. The hardest hit area was downtown near the neighborhoods of Tarrytown and Hyde Park, University of Texas campus, and the Interstate 35 corridor just north of the river. The combination of baseball size hail and winds of 70 to 80 mph blew out building and apartment windows throughout this area. Windows on the Texas Capitol building were blown out as well. Lion's golf course and the Morris Williams course sustained damage and had to briefly close. Power was knocked off to nearly 20,000 customers. Large old oak trees were damaged and the City of Austin spent over 2 million dollars in cleanup and response. Total monetary losses are estimated at 50 million dollars.

#### **April 4, 1997 – City of Austin**

Storms ripped roofs off 16 apartment buildings in the City of Austin. High winds also resulted in widespread (1,500) power failures across the City of Austin. Aircrafts were damaged at Robert Mueller Airport by severe wind gusts.

#### **September 7, 1995 – City of Austin**

Power was out to 75,000 homes and businesses. Numerous structural fires occurred due to lightning strikes. Hundreds of power and phone lines were down leaving many without power for over 48 hours. The combined effect of high winds and heavy rain caused the collapse of a wall in one building and destroyed the roof of another building in a downtown apartment complex. This forced the evacuation of 50 residents. The driver and passenger in a vehicle were injured when a construction barrier was blown over onto their truck. Another driver was injured slightly when lightning struck a truck, tossing out bricks that were stacked in the truck bed. Other minor injuries were reported in the City of Austin due to flying pieces of broken glass. A boatload of tourists on Lake Travis had to be rescued due to rough waters stirred up by high winds. Several football games were cancelled or terminated early, preventing potential injuries.

### Probability of Future Events

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Most thunderstorms occur during the spring, in the months of March, April and May, and in the fall, during the month of September. Even though the intensity of thunderstorm winds is not always damaging for the entire planning area, the frequency of occurrence for a thunderstorm wind event is highly likely, meaning that two to three events are probable for every year for the City of Austin and AISD.

### Vulnerability and Impact

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Vulnerability is difficult to evaluate since thunderstorm wind events can occur at different strength levels, in random locations, and can create relatively narrow paths of destruction. Due to the randomness of this event, all existing and future structures, and facilities in the City of Austin's planning area could potentially be impacted and remain vulnerable to possible injury and/or property loss from hail and strong winds associated with severe thunderstorm. AISD is equally vulnerable to the impact of a thunderstorm wind event. The school district utilizes more than 630 portable buildings at their school campuses to facilitate shifts in school populations. These portable buildings would be more vulnerable to thunderstorm events than the typical site built structures at each campus.

Trees, power lines and poles, signage, manufactured housing, radio towers, concrete block walls, storage barns, windows, garbage receptacles, brick facades, and vehicles, unless reinforced, are vulnerable to severe winds associated with thunderstorm events. More severe damage involves windborne debris—in some instances, patio furniture and other lawn items have been reported to have been blown around by wind and, very commonly, debris from damaged structures in turn have caused damage to other buildings not directly impacted by the event. In numerous instances roofs have been reported as having been torn off of buildings.

Extreme thunderstorm wind events have the potential to pose a significant risk to people, and can create dangerous and difficult situations for public health and safety officials. Individuals who are exposed to the storm can be struck by flying debris, falling limbs, or downed trees. Residential structures can be damaged, or crushed by falling trees, which can result in physical harm to the home's occupants. Students at Austin Independent School District locations are also susceptible to injury from flying debris as sporting events and practices are often held outside during early fall or late spring. Austin ISD may postpone or cancel all outdoor activities due thunderstorm wind events, to ensure the safety of their faculty, students and all other attendees.

During exceptionally heavy wind events, the winds may reach speeds in which it is unsafe to operate emergency vehicles and equipment, therefore preventing first responders from responding to emergency calls from the public. Large amounts of debris on the roadways, such as downed trees, can result in emergency response vehicles being unable to access areas of the City planning area. Additionally, downed power lines that are still energized are extremely dangerous and may result in roadways being unsafe for use, which may prevent first responders from responding to calls for assistance. Response personnel are subject to the same health and safety concerns that can impact the general public. Downed power lines, damaged structures, hazardous spills, and unrecognizable or unusual debris that often accompany a thunderstorm wind event can pose a significant risk to response personnel.

Thunderstorm wind events often result in power outages over widespread areas. If generators are not available, those individuals who rely on power for health and life safety, such as those on life support

## Section 9: Thunderstorm Wind

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systems, could be placed in jeopardy. Also, extended power outage often results in an increase in structure fires and carbon monoxide poisoning, as individuals use alternate, unsafe cooking or heating devices, such as grills, to attempt to cook or heat their homes.

Thunderstorm wind is a threat to operations and service delivery within the City planning area, and has the potential to significantly impact local government's continuity of operations. While the City of Austin Office of Homeland Security and Emergency Management has a protected facility from which to operate, roadway debris or other obstructions may prevent the staff from accessing the facility. Staff members unable to access the protected facility would be limited to performing work with the resources that were accessible to them from their remote location.

Other City departments may not be as protected as the City of Austin HSEM, and may suffer more interruptions as a result of damages from thunderstorm winds. If files (hard or electronic) are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the area, and could negatively impact response recovery from the event. Without a plan that takes into account department-specific issues, or regular exercise of that plan, critical departments may not be able to function and provide necessary services.

The same is true for private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers. If, for example, debris downed by thunderstorm winds resulted in the closure of roadways over a large area, this would result in a temporary halt to any repair of damaged infrastructure, impede emergency response activities, and result in a complete interruption in the normal delivery of goods and services.

The Austin Independent School District is also at risk for damages from thunderstorm wind events. Damages to the district's buildings or power outages could make the schools unsafe for students to attend. The Austin ISD will also have to consider the safety of the students during transportation to and from the schools, especially if widespread road closures result from downed debris.

Damaged electrical substations, downed power lines, and roadway obstructions are all common occurrences during thunderstorm wind events, and all of these will impact a community's normal operations and service delivery. It is imperative that the community, both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed.

Thunderstorm winds are a natural phenomenon, and are unlikely to result in catastrophic or prolonged natural or environmental damages. However, the effects of thunderstorm wind does pose a risk on the built environment, as damages to the built environment may result in both catastrophic and prolonged damage to the environment. For example, a chemical facility that is damaged by thunderstorm winds and begins leaking hazardous chemicals into the environment could pose a significant and long-term risk to the environment, and, depending on what is affected, to the human, animal, and plants that rely on that environment for health and survival. Some of these materials may take years, decades, or even longer to break down and become harmless; some materials may never fully break down. Until the chemicals break down, they can continue to degrade the environment where they have come to rest, in some cases leaching back into the water course or into ground water spreading contamination away from the site. Without clean-up this may continue for years.

The potential risks of thunderstorm wind to the area are not limited to property damages and loss of life; financial and economic risks associated with extreme winds may also be significant. While an individual residential structure that is damaged by wind can be devastating to the residents, it has a

## Section 9: Thunderstorm Wind

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negligible impact on the community's overall economic health. However, a significant thunderstorm wind event, which damages or destroys a large number of structures, can have serious economic and financial consequences for a community.

The City of Austin planning area is home to a large number of cultural and historic resources. These historic and cultural resources are a significant draw for tourists and visitors to the area, and help to generate revenue through taxes and fees. This revenue in turn pays for City services and programs, which benefit residents and the community. Many of the historic neighborhoods may be at risk from a thunderstorm wind event, as they are of a construction type and material that is more vulnerable to extreme winds. In addition to the costs of restoring the property from damages, the revenue may face a decrease, as tourists and visitors may not be allowed to visit these historical sites while they are being repaired.

Large scale wind events can cause significant property damage, to homes, businesses, industrial properties, and government buildings. This can have significant economic impact on the affected area, as it must now fund unforeseen and unbudgeted expenses such as infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, as well as normal day-to-day operating expenses. While there are often state and federal programs that can help with these expenses, the majority of these programs are reimbursement programs, meaning that the local government must still fund the initial expenses out of pocket.

Significant thunderstorm wind events can also result in dramatic population fluctuations, as people are unable to return to their homes or jobs and may seek shelter and work outside of the affected area. They may require temporary relocation assistance, and some of them may choose not to return to the community. Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community. This loss of jobs affects the financial and economic health and stability of the community, and may result in an increase in the unemployment rate.

Extreme wind typically damages the infrastructure of a community, including roads, bridges, power lines and power plants. It can take a significant amount of time to fully repair such facilities and infrastructure, depending on the nature of the damage and the resources available that can be dedicated to the project. Damage to infrastructure will generally slow down the economic recovery of the community, as it often slows the re-opening of businesses and can limit the clean-up effort. There are some businesses that are more reliant on utility infrastructure than others. Grocery stores, for example, are typically reliant on electricity to maintain the safety of their food supply. Some larger chains may have emergency power generators and fuel on hand, but smaller, independent stores often do not. Some businesses may be forced to close temporarily, even those that were not directly impacted by the event, and for some businesses, the loss of infrastructure can result in the failure of their business.

The economic and financial impacts of thunderstorm wind on the planning area will depend entirely on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by businesses, citizens, and the Austin ISD will also contribute to the overall economic and financial conditions in the aftermath of any thunderstorm wind event.

Impact of thunderstorm wind events experienced in the City of Austin planning area would be "Minor," meaning injuries and illnesses do not result in permanent disability, shutdown of facilities and services will be for more than one week, and more than ten percent of property is destroyed or with major damage. Overall, the average loss estimate (in 2015 dollars) is \$69,392,042, having an approximate annual loss estimate of \$1,239,144.

# Section 10: Hail

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## Hazard Description

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Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low pressure front due to the rapid rising of warm air into the upper atmosphere, and the subsequent cooling of the air mass. Frozen droplets gradually accumulate into ice crystals, until they fall as precipitation that is round or irregularly shaped masses of ice greater than 0.75 inches in diameter. The size of hailstones is a direct result of the size and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The strength of the updraft

is a byproduct of heating on the Earth’s surface. Higher temperature gradients above Earth’s surface result in increased suspension time and hailstone size.

## Location

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Hailstorms are not confined to any specific geographic location, and can vary greatly in terms of size, location, intensity and duration. All areas for the City of Austin, including Austin Independent School District (AISD), are considered to be exposed to this hazard equally.

## Extent

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The National Weather Service (NWS) classifies a storm as “Severe,” if hail of three-quarters of an inch in diameter (approximately the size of a penny) or greater are present. The size determination is based on radar intensity or seen by observers. The intensity category of a hailstorm depends on its size and the potential damage it could cause, as depicted in the National Climatic Data Center (NCDC) Intensity Scale in Table 10-1.

## Section 10: Hail

**Table 10-1. Hail Intensity and Magnitude<sup>1</sup>**

SIZE CODE	INTENSITY CATEGORY	SIZE (Diameter Inches)	DESCRIPTIVE TERM	TYPICAL DAMAGE
<b>H0</b>	Hard Hail	Up to 0.33	Pea	No damage
<b>H1</b>	Potentially Damaging	0.33 – 0.60	Marble	Slight damage to plants and crops
<b>H2</b>	Potentially Damaging	0.60 – 0.80	Dime	Significant damage to plants and crops
<b>H3</b>	Severe	0.80 – 1.20	Nickel	Severe damage to plants and crops
<b>H4</b>	Severe	1.2 – 1.6	Quarter	Widespread glass and auto damage
<b>H5</b>	Destructive	1.6 – 2.0	Half Dollar	Widespread destruction of glass, roofs, and risk of injuries
<b>H6</b>	Destructive	2.0 – 2.4	Ping Pong Ball	Aircraft bodywork dented and brick walls pitted
<b>H7</b>	Very Destructive	2.4 – 3.0	Golf Ball	Severe roof damage and risk of serious injuries
<b>H8</b>	Very Destructive	3.0 – 3.5	Hen Egg	Severe damage to all structures
<b>H9</b>	Super Hailstorms	3.5 – 4.0	Tennis Ball	Extensive structural damage, could cause fatal injuries
<b>H10</b>	Super Hailstorms	4.0 +	Baseball	Extensive structural damage, could cause fatal injuries

The scale in Table 10-1 extends from H0 to H10, with increments of intensity or damage potential related to hail size (distribution and maximum), texture, fall speed, speed of storm translation, and strength of the accompanying wind.

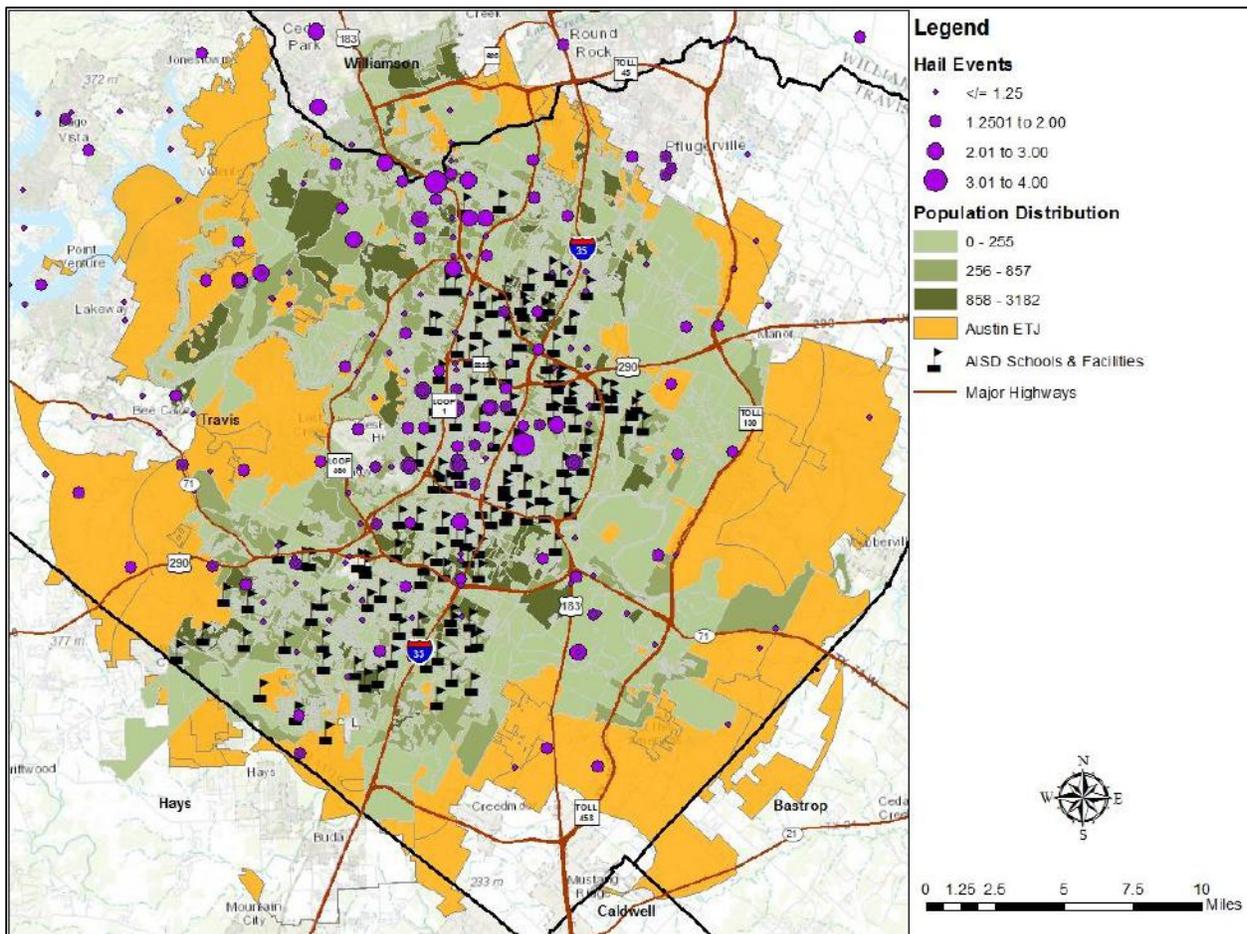
The City of Austin experienced two of the worst hailstorms in its history in May of 2008 and March of 2009. Reports indicate that the magnitude of the March 25, 2009 event was close to an H8 or H9 in terms of size and may have caused up to \$160 million in damages. The May 2008 event caused approximately \$50 million in damages with a magnitude of H9. Although both storms were rare, they indicate the potential destructiveness and danger of an intense hailstorm. Therefore, the City of Austin can mitigate a storm from H0 – non-damaging pea size hail, up to a H9 – super hailstorm with tennis ball size hail that leads to severe roof damage and risk of serious injuries.

<sup>1</sup> NCDC Intensity Scale, based on the TORRO Hailstorm Intensity Scale.

## Historical Occurrences

Historical evidence shown in Figure 10-1 shows that the planning area is vulnerable to hail events overall, which typically result from severe thunderstorm activity. Between 1955 and 2014, 162 historical hail events are known to have impacted the City of Austin including the AISD (Table 10-2). These hail events represent only those that were reported to NCDC, National Oceanic and Atmospheric Administration (NOAA), and Spatial Hazard Events & Losses Database for the United States (SHELDUS) databases, and may not represent all hail events to have occurred during the past 59 years. Only those events for Travis County with latitude and longitude available were plotted on the map (Figure 10-1).

Figure 10-1. Spatial Historical Hail Events, 1955–2014<sup>2</sup>



Only hail events that have been reported have been factored into this Risk Assessment. It is likely that additional hail occurrences have gone unreported before and during the recording period. Table 10-2 shows historical incident information for the planning area which resulted in property, or crop damage.

<sup>2</sup> Source: NOAA/NCDC Records

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**Table 10-2. Historical Hail Events, 1955-2014**

DATE	TIME	MAGNITUDE	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
5/26/1976	5:30 PM	2.50	\$50,000	\$5,000	\$205,366	\$20,537
4/14/1977	10:00 PM	1.75	\$50,000	\$5,000	\$192,828	\$19,283
3/23/1978	7:45 PM	1.75	\$2,500	\$250.00	\$8,961	\$896
5/8/1980	10:00 PM	1.00	\$5,000,000	\$ 500,000	\$1,418,125	\$1,418,125
4/19/1982	8:10 AM	3.00	\$5,000	\$0	\$12,109	\$0
10/21/1984	8:27 PM	2.00	\$5,000,000	\$0	\$11,246,728	\$0
3/25/1993	5:37 PM	0.75	\$0	\$5,000	\$0	\$8,087
3/25/1993	5:39 PM	1.75	\$50,000	\$0	\$80,867	\$0
3/25/1993	6:25 PM	1.75	\$500,000	\$0	\$808,675	\$0
3/25/1993	6:30 PM	0.88	\$0	\$5,000	\$0	\$8,087
3/25/1993	7:00 PM	2.00	\$75,000,000	\$5,000	\$121,301,211	\$8,087
4/5/1994	12:15 AM	0.75	\$500,000	\$50,000	\$788,485	\$78,849
10/17/1996	4:42 PM	-	\$10,000	\$0	\$14,895	\$0
10/17/1996	4:10 AM	1.50	\$20,000	\$0	\$29,791	\$0
10/20/2002	8:05 PM	1.75	\$500,000	\$0	\$649,547	\$0
8/11/2003	3:15 PM	1.75	\$100,000	\$0	\$127,015	\$0
5/14/2008	11:30 PM	2.75	\$100,000	\$0	\$108,548	\$0
5/14/2008	11:35 PM	2.75	\$100,000	\$0	\$108,548	\$0
5/14/2008	11:45 PM	4.00	\$1,000	\$0	\$1,085	\$0
5/14/2008	8:30 PM	1.75	\$1,000	\$0	\$1,085	\$0
5/14/2008	12:15 AM	2.00	\$100,000	\$0	\$108,548	\$0
4/27/2014	7:15 PM	1.25	\$1,000	\$0	\$987	\$0

## Section 10: Hail

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Based on the list of historical hail events for the City of Austin (listed above), 40 of the events occurred after the 2010 Plan Update. These events are from the date of June 2008 through November 2014. It is important to note that the AISD schools and facilities are all located within the City of Austin planning area. There may be some occurrences that have occurred for the AISD and may not have been recorded, but are included in the City of Austin occurrence data because of their location. Only hail events that have been reported have been factored into this Risk Assessment. It is likely that additional hail occurrences have gone unreported before and during the recording period. Table 10-3 shows the annualized losses based on historical incident information for the planning area which resulted in property or crop damage.

**Table 10-3. Summary of Historical Hail Events, 1955-2014**

EVENTS	MAGNITUDE (Inches)	DEATHS	INJURIES	PROPERTY DAMAGE (2015 Dollars)	CROP DAMAGE (2015 Dollars)
162	4.0	0	0	\$137,213,404.82	\$1,561,949.29
	(max extent)				

### Significant Past Events

#### **April 27, 2014 – City of Austin**

A cold front pushed the dry-line ahead of it into eastern sections of South Central Texas and caused thunderstorms. Some of these storms produced large hail. In Elroy, a thunderstorm produced 1.25 inch hail that damaged a plastic patio cover.

#### **January 24, 2012 – City of Austin**

A deep upper level low pressure center brought a frontal system through Texas which caused thunderstorms across South Central Texas. These storms formed into a mesoscale convective system and produced several tornadoes, wind damage, large hail, and heavy rain that resulted in flash flooding.

#### **March 25, 2009 – City of Austin**

A cold front stalled across South Central Texas on the morning of March 25, 2009. The subtropical jet and a mid/upper-level short wave trough pushed into the region. Convection initiated across the San Angelo County warning area in the morning and spread to the southwest. Thunderstorms reached the Edwards Plateau by early afternoon and continued moving east into the evening. Total estimated loss from this storm is around \$160 million dollars, the most ever for a hail storm in the City of Austin. The top three hail storms that have hit the City of Austin have all occurred on a March 25th. March 25, 1993 saw losses at \$125 million, and March 25, 2005 had \$100 million in losses. A thunderstorm moved through the north Austin and Round Rock area, and produced hail ranging in size from golf ball to hen egg size. NOAA received three reports of severe hail with this storm. This hail dented cars and caused minor damage to some roof shingles in the north Austin area.

#### **May 14, 2008 – City of Austin**

A severe thunderstorm to the southwest of Austin moved northeast across the downtown area causing extensive damage from winds and large hail. Golf ball to baseball size hail damaged 26 cars at the Combined Transportation, Emergency and Communications Center (CTECC).

## Section 10: Hail

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### **October 20, 2002 – City of Austin**

Large hail dented roofs and broke windows in mainly the southwest part of the City of Austin. Some home owners reported holes in their roofs from the hail.

### **April 5, 1994 – City of Austin**

Numerous reports were received of 0.75-inch hail over west Austin by thunderstorms moving toward the southeast at 20 mph.

### **March 25, 1993 – City of Austin**

During the evening hours, north and northeast Austin were hit by large hail. An estimated \$125 million in damage was reported to cars, roofs, greenhouses and vegetation.

## Probability of Future Events

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Based on the 162 events over the last 59 years (1955 – 2014), a hail event is a highly likely occurrence for the City of Austin and AISD and is estimated to occur approximately one event every year. Most hailstorms occur during the spring (March, April and May), and in the fall during the month of September. Warning time for a hailstorm is generally minimal or there is no warning.

## Vulnerability and Impact

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Damage from hail approaches \$1 billion in the U.S. each year. Much of the damage inflicted by hail is to crops. Even relatively small hail can shred plants to ribbons in a matter of minutes. Vehicles, roofs of buildings, homes, and landscaping are the other things most commonly damaged by hail.

Utility systems on roofs at schools would be vulnerable and could be damaged. Hail can cause significant threat to people as they could be struck by hail and falling trees and branches. First responders could not be able to respond to calls due to blocked roads. Also, hail can cause power outages which could cause health and safety risks to faculty and students at schools. The AISD is comprised of 142 facilities including school campuses and support facilities such as administrative, athletics, transportation and support facilities. While all facilities would be equally vulnerable to damages from hail, structures with roof top utility systems could be exposed to greater damages. The school district utilizes more than 630 portable buildings at their school campuses to facilitate shifts in school populations. These portable buildings would be more vulnerable to hail events than the typical site built structures at each campus. If these portable buildings were damaged, it would leave students displaced and there are not enough hardened facilities to accept these students. Hail events during school hours could elevate the risk to students and faculty due to broken windows and flying debris as well as increased health and safety risks during outdoor events.

The City of Austin typically experiences hail storms every year. Most structures in the planning area can resist the effects of all but the most severe hailstorms. The planning area does have a number of mobile and manufactured home parks which are more vulnerable to severe weather than site built structures. If these homes were damaged, the City of Austin would not have enough housing and the residents would be displaced. Public safety facilities, infrastructure, and special facilities do not have a history of being vulnerable to hailstorms. Vehicles have proven to be extremely vulnerable to hailstorms with widespread vehicle damage possible in small hail events.

## Section 10: Hail

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Hail has been known to cause injury to humans, and occasionally has been fatal. Overall, the average loss estimate of property and crops (in 2015 dollars) is \$138,775,354, having an approximate annual loss estimate of \$2,891,153. Based on historic loss and damages, the impact of hail damages on the City of Austin planning area, including AISD, can be considered “Minor” severity of impact, meaning injuries and illnesses are possible but may not result in permanent disability, shutdown of facilities and services for more than a week, and more than ten percent of property is destroyed or experiences major damage.

# Section 11: Tornado

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## Hazard Description



Tornadoes are among the most violent storms on the planet. A tornado is a violently rotating column of air extending between, and in contact with, a cloud and the surface of the earth. The most violent tornadoes are capable of tremendous destruction, with wind speeds of 250 miles per hour or more. In extreme cases, winds may approach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long.

The most powerful tornadoes are produced by “super cell thunderstorms.” Super-cell thunderstorms are created when horizontal wind shears (winds moving in different directions at different altitudes) begin to rotate the storm. This horizontal rotation can be tilted vertically by violent updrafts, and the rotation radius can shrink, forming a vertical column of very quickly swirling air. This rotating air can eventually reach the ground, forming a tornado.

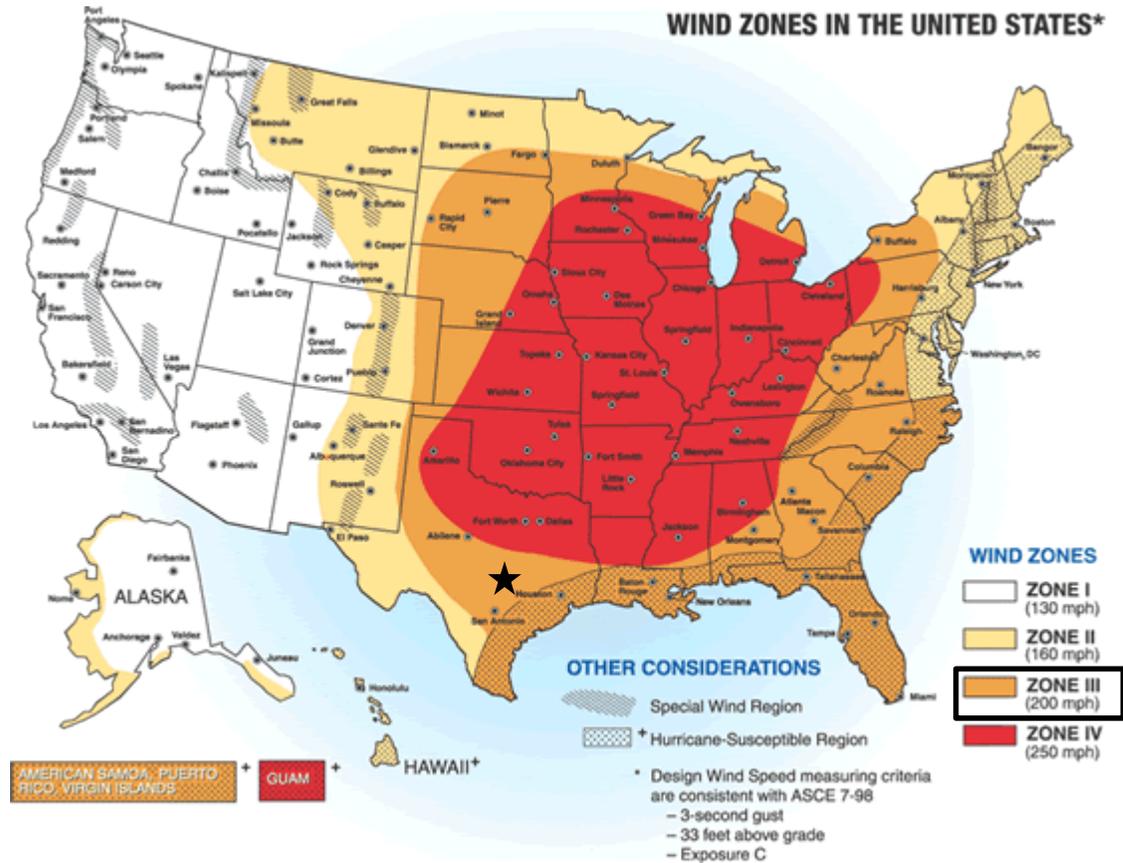
**Table 11-1. Tornado Variations**

WEAK TORNADOES	STRONG TORNADOES	VIOLENT TORNADOES
<ul style="list-style-type: none"> <li>• 69% of all tornadoes</li> <li>• Less than 5% of tornado deaths</li> <li>• Lifetime 1-10+ minutes</li> <li>• Winds less than 110 mph</li> </ul>	<ul style="list-style-type: none"> <li>• 29% of all tornadoes</li> <li>• Nearly 30% of all tornado deaths</li> <li>• Lifetime 20+ minutes</li> <li>• Winds 110 – 205 mph</li> </ul>	<ul style="list-style-type: none"> <li>• 2% of all tornadoes</li> <li>• 70% of all tornado deaths</li> <li>• Lifetime can exceed one hour</li> <li>• Winds greater than 205 mph</li> </ul>

## Location

As with thunderstorms, tornadoes do not have any specific geographic boundary and can occur throughout the City of Austin and AISD planning area. It is assumed that the City of Austin planning area is uniformly exposed to tornado activity. The City of Austin, including AISD, is located in Wind Zone III, meaning tornado winds can be as high as 200 mph.

**Figure 11-1. FEMA Wind Zones in the United States<sup>1</sup>**



## Extent

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, such as residential homes, and particularly mobile homes.

Tornado magnitudes prior to 2005 were determined using the traditional version of the Fujita Scale (Table 11-2). Since February 2007, the Fujita Scale (FS) has been replaced by the Enhanced Fujita Scale (EFS) (Table 11-3), which retains the same basic design as its predecessor with six strength categories. The newer scale reflects more refined assessments of tornado damage surveys, standardization, and damage consideration to a wider range of structures.

<sup>1</sup> The City of Austin is indicated by the star.

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**Table 11-2. The Fujita Tornado Scale<sup>2</sup>**

F-SCALE NUMBER	INTENSITY	WIND SPEED (MPH)	TYPE OF DAMAGE DONE	PERCENT OF APPRAISED STRUCTURE VALUE LOST DUE TO DAMAGE
<b>F0</b>	Gale Tornado	40 – 72	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; and damages sign boards.	None Estimated
<b>F1</b>	Moderate Tornado	73 – 112	The lower wind speed is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; and attached garages may be destroyed.	0% – 20%
<b>F2</b>	Significant Tornado	113 – 157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; and light object missiles generated.	50% – 100%
<b>F3</b>	Severe Tornado	158 – 206	Roofs and some walls torn off well-constructed houses; trains overturned; and most trees in forest uprooted.	100%
<b>F4</b>	Devastating Tornado	207 – 260	Well-constructed homes leveled; structures with weak foundations blown off some distance; and cars thrown and large missiles generated.	100%
<b>F5</b>	Incredible Tornado	261 – 318	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 330 yards; trees debarked; and steel reinforced concrete badly damaged.	100%

<sup>2</sup> Source: <http://www.tornadoproject.com/fscale/fscale.htm>

**Table 11-3. Enhanced Fujita Scale for Tornadoes**

STORM CATEGORY	DAMAGE LEVEL	3 SECOND GUST (MPH)	DESCRIPTION OF DAMAGES	PHOTO EXAMPLE
<b>EF0</b>	Gale	65 – 85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; and damages sign boards.	
<b>EF1</b>	Weak	86 – 110	The lower wind speed is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads; and attached garages may be destroyed.	
<b>EF2</b>	Strong	111 – 135	Considerable damage; roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; and light object missiles generated.	
<b>EF3</b>	Severe	136 – 165	Roof and some walls torn off well-constructed houses; trains overturned; and most trees in forest uprooted.	
<b>EF4</b>	Devastating	166 – 200	Well-constructed homes leveled; structures with weak foundations blown off some distance; and cars thrown and large missiles generated.	
<b>EF5</b>	Incredible	200+	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles flying through the air in excess of 330 yards; trees debarked; and steel reinforced concrete badly damaged.	

Both the Fujita Scale and Enhanced Fujita Scale are referenced in reviewing previous occurrences as tornado events prior to 2007 follow the Fujita Scale. The largest tornado magnitude reported within the City of Austin planning area was an F3 on the Fujita Scale, or a severe tornado.

Although, the Austin planning area, including AISD, could experience a storm with a category up to an EF3 depending on the wind speed, the majority of storms only rise to a level of EF0 to an EF2 (Table 11-4). Therefore, the range of intensity that the City of Austin planning area would be expected to mitigate for a tornado event would be a “low” to “severe” risk, or an EF0 to an EF3.

## Historical Occurrences

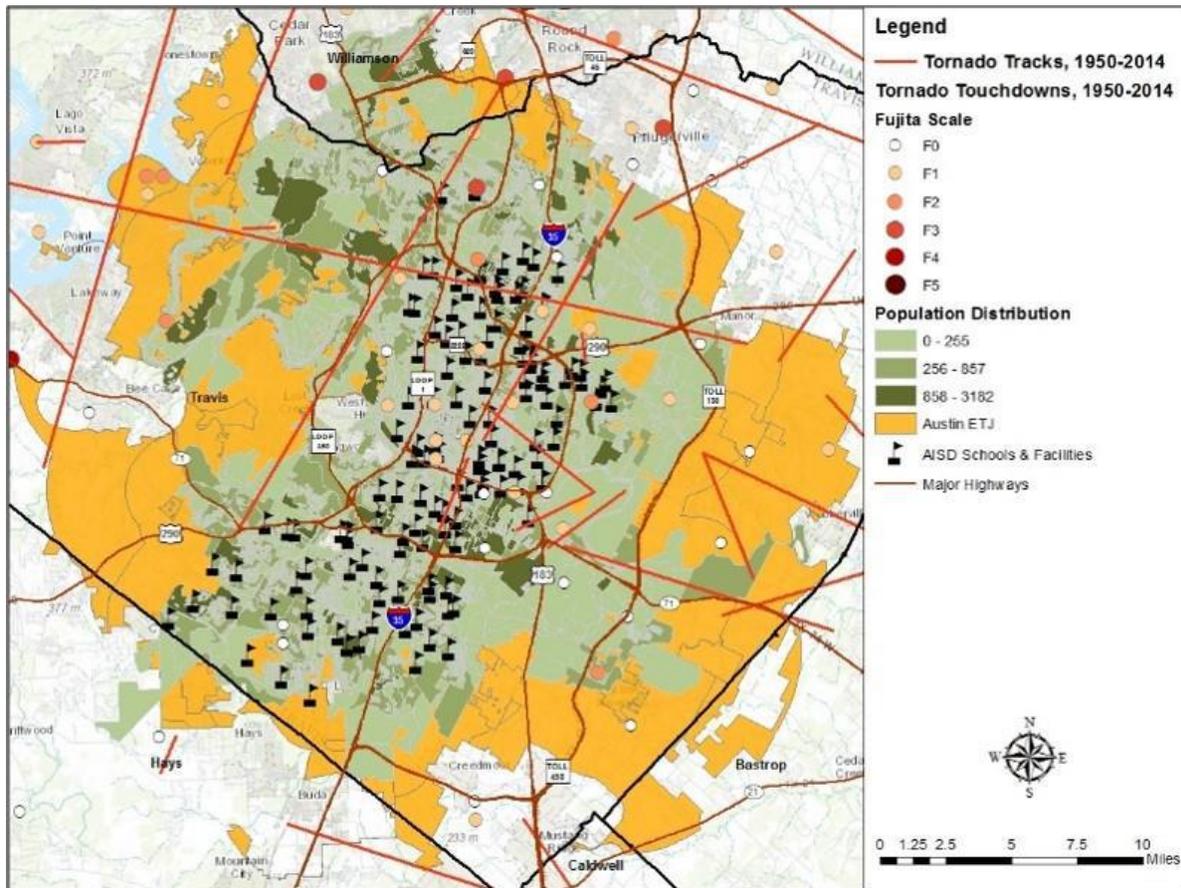
A total of 61 tornado events have been recorded for the City of Austin and AISD planning area from 1950 to 2014 as shown in Figure 11-2. One severe storm event was categorized as a severe tornado

## Section 11: Tornado

(F3); four events were significant tornadoes (F2); 13 events were categorized as moderate tornadoes (F1); and the other 12 were gale force tornadoes (F0).

The events shown in Figure 11-2 and listed in Table 11-4 represent only those that were reported to NCDC, NOAA, and SHELDUS databases, and may not represent all tornado events that have occurred since 1950. Only those events with latitude and longitude available were plotted on the map (Figure 11-2).

**Figure 11-2. Spatial Historical Tornado Events, 1950–2014<sup>3</sup>**



<sup>3</sup> Source: NOAA Records

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**Table 11-4. Historical Tornado Events, 1950-2014**

DATE	TIME	MAGNITUDE	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 Dollars)	CROP DAMAGE (2015 Dollars)
10/23/1953	1:00 AM	F1	\$25,000	\$0	\$218,827	\$0
10/20/1956	12:56 PM	F1	\$0	\$0	\$0	\$0
3/31/1957	9:05 AM	F2	\$250,000	\$0	\$2,079,244	\$0
5/10/1959	3:20 PM	F3	\$ 250,000	\$0	\$2,007,792	\$0
7/20/1960	6:15 AM	F1	\$2,500	\$0	\$19,739	\$0
4/16/1964	3:00 PM	F0	\$0	\$0	\$0	\$0
5/17/1965	1:30 AM	F1	\$250	\$0	\$2,226	\$0
9/20/1967	10:00 AM	F1	\$2,500	\$0	\$17,493	\$0
9/20/1967	10:00 AM	F0	\$2,500	\$0	\$17,493	\$0
9/21/1967	12:00 PM	F0	\$2,500	\$0	\$17,493	\$0
7/4/1970	6:00 PM	F2	\$0	\$0	\$30,117	\$0
8/3/1972	11:10 AM	F0	\$25,000	\$0	\$139,777	\$0
1/20/1973	9:00 PM	F2	\$25,000	\$0	\$26,318	\$0
3/6/1973	8:05 AM	F1	\$0	\$0	\$0	\$0
3/10/1973	5:45 AM	F1	\$250,000	\$0	\$1,315,918	\$0
5/5/1975	1:25 PM	F0	\$0	\$0	\$0	\$0
5/23/1975	3:15 PM	F0	\$0	\$0	\$21,720	\$0
5/29/1975	7:00 AM	F1	\$0	\$0	\$0	\$0
3/5/1976	1:15 AM	F0	\$25,000	\$0	\$123,220	\$0
5/12/1976	7:50 PM	F1	\$0	\$0	\$205,366	\$0
5/1/1979	9:33 AM	F0	\$0	\$0	\$0	\$0
8/10/1980	1:40 PM	F2	\$250,000,000	\$0	\$709,062,500	\$0
6/13/1981	3:00 PM	F1	\$25,000	\$0	\$64,276	\$0
5/18/1990	5:25 PM	F0	\$0	\$0	\$0	\$0
5/27/1997	3:15 PM	F1	\$5,000	\$0	\$14,561	\$0

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DATE	TIME	MAGNITUDE	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 Dollars)	CROP DAMAGE (2015 Dollars)
3/16/2000	4:20 PM	F0	\$0	\$0	\$0	\$0
11/15/2001	3:50 PM	F1	\$100,000	\$0	\$131,963	\$0
11/15/2001	4:45 PM	F0	\$30,000	\$0	\$39,589	\$0
11/15/2001	5:30 PM	F1	\$80,000	\$0	\$105,571	\$0
11/15/2001	5:44 PM	F0	\$15,000	\$0	\$19,794	\$0
6/8/2004	7:45 PM	F0	\$150,000	\$0	\$185,580	\$0

**Table 11-5. Summary of Historical Tornado Events, 1950-2014**

EVENTS	MAGNITUDE (Fujita)	DEATHS	INJURIES	PROPERTY DAMAGE (2015 Dollars)	CROP DAMAGE (2015 Dollars)
31 events	F3	11	1	\$715,680,997	\$0
	(max extent)				

Based on the list of historical tornado events for the City of Austin (listed above), there have been no events on record since the 2010 Plan Update. It is important to note that AISD schools and facilities are within the city of Austin planning area. There may be some occurrences that have occurred for the AISD and may not have been recorded, but are included in the City of Austin occurrence data because of their location. No tornado events are known to have previously occurred at any AISD locations. AISD has no record of an event occurrence since the 2010 Plan Update.

### Significant Past Events

#### November 15, 2001 – City of Austin

An F1 tornado estimated to be .25 mile wide formed at a location near William Cannon Road and about .25 mile east of I-35 in Austin. The tornado moved northeast for just over two miles. In the North Bluff Estates Trailer Park, at least two dozen mobile homes sustained minor to extensive damage. One mobile home was overturned upside down against another mobile home and a car. The mobile home was tied-down. There were no reports of injuries as both trailers were empty at the time. In addition, tree and roof damage was evident to businesses in the area and an apartment complex across William Cannon from the trailer park. Several trees were sheared at the top or completely uprooted. One pickup truck was lifted and placed on top of a pile of debris. It is possible there were two tornadoes in this event, especially due to the width of the damage path. However, based on the reports received, and the survey made, the best conclusion is that one tornado occurred.

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### **May 27, 1997 – City of Austin**

The Cedar Park tornado formed around 3:05 pm CST from a different supercell thunderstorm. The tornado first touched down about 3.5 miles north of Cedar Park at a location 0.6 miles south of CR 178 and 1.4 miles east of the intersection of US 183 and CR 178. The initial damage was to trees, however, the ground survey revealed damage nearby to a church and a trucking company. The aerial survey did not reflect the nearby damage as being in line with the damage path. It is quite possible this damage was caused by strong wind near the tornado. The beginning point was in a relatively open area with damage primarily to a few trees and minor shingle damage to one house.

The tornado moved south-southwestward skirting a residential area before it crossed CR 180 immediately east of US 183. A historic train located on the north side of CR 180 just to the east of US 183 was in the direct path of the tornado. While the engine remained on the track, a coal tender converted to hold diesel fuel and weighing approximately 65,000 pounds, including the 1,000 gallons of diesel fuel, was flipped over and thrown a short distance.

Continuing across CR 180, the tornado entered a shopping center where it weakened and slightly pushed the north wall of a grocery store inward. It also pushed large metal doors inward that were built to open toward the outside. Damage at this point had been generally F2 and briefly F3 as the tornado knocked the train tender off the track and damaged the wall and doors of the food store. It tore off much of a weakly supported roof of a grocery store. The manager of the store, who had been a victim of the Wichita Falls Tornado of 1979, saw the approaching tornado, and made an announcement to all in the store to meet him in the middle of the store. He then led everyone he could gather into the meat locker. This very quick and decisive action probably saved several lives.

The tornado crossed US 183 causing additional damage to a number of businesses. One business on the west side of US 183 lost nearly the entire roof. Most damage to other businesses was minor. After crossing US 183 the tornado moved across Marquis Lane and North Park Circle through an area with widely scattered housing and a relative abundance of trees. Again, most damage to structures in this area was minor.

From North Park Circle the tornado moved into the northwestern portion of Buttercup Creek, a subdivision of well-constructed homes. At this point the damage level ranged from F0 to F2. Damage to homes was irregular with one house losing a roof but the house next door losing only shingles. Two homes in the area were nearly destroyed. One home was damaged when a pickup truck was lifted and tossed against its front wall. Eleven homes were destroyed, with damage reported to over 100 homes. The tornado track was taking a gentle right turn when it became more southwesterly. The tornado moved into a wooded area crossing into Travis County before ending 1.1 miles from Lake Travis. Damage in the wooded area was irregular ranging from near total destruction of all trees to sections with about ten percent of the trees down.

### **July 4, 1970 – City of Austin**

A small tornado and high thunderstorm winds ripped through resort areas on Lake Travis northwest of Austin, resulting in the death of one person while injuring four others. The Hurst Creek boat dock was reduced to a twisted mass of metal by the storm. An individual drowned when he and his spouse were caught underneath the 100 foot dock. Although injured, his spouse came to the surface and was rescued. Three other persons were injured at the Hurst Creek docks. The storm also hit the Lakeway area, two miles east of the Hurst Creek dock, ripping the roofs off several houses and damaging a dock at the marina. Several persons were injured by flying glass, but none required hospitalization.

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During the height of the storm, an iron pipe was driven through the roof of the one lakeside home near the Hurst Creek docks. The pipe dropped into the living room but injured no one.

### Probability of Future Events

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Tornadic storms can occur at any time of year and at any time of day, but they are typically more common in the spring months during the late afternoon and evening hours. A smaller, high frequency storm period can also emerge in the fall, during the brief transition between the warm and cold seasons. According to historical records, the City of Austin experiences a tornado touchdown every one to two years. Hence, the probability of future tornado occurrences affecting the City of Austin and AISD is highly likely, meaning an event may occur in the next 2 years.

### Vulnerability and Impact

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Because tornadoes often cross-jurisdictional boundaries, all existing and future buildings, facilities and populations in the City of Austin, including AISD, are considered to be exposed to this hazard and could potentially be impacted. The damage caused by a tornado is typically a result of high wind velocity, wind-blown debris, and large hail.

The average tornado moves from southwest to northeast. However, tornadoes have been known to move in any direction at different strengths, in random locations, and typically create relatively narrow paths of destruction. Thus, it is difficult to evaluate the vulnerability of people and property to the impacts of a tornado. Although tornadoes strike at random, making all buildings vulnerable, three types of structures are more likely to suffer damage:

- Manufactured Homes;
- Homes on crawlspaces (more susceptible to lift); and
- Buildings that span a large area, such as shopping malls, gymnasiums, and factories.



Trees, power lines and poles, signage, manufactured housing, radio towers, concrete block walls, storage barns, windows, garbage receptacles, brick facades, and vehicles, unless reinforced, are vulnerable to severe winds associated with tornado events. More severe damage involves windborne debris—in some instances, patio furniture and other lawn items have been reported to have been blown around by wind and, very commonly, debris from damaged structures in turn have caused damage to other buildings not directly impacted by the event. In numerous instances roofs have been reported as having been torn off of buildings.

Utility systems on roofs at schools would be vulnerable and could be damaged by debris and high winds. Tornadoes can possibly cause a significant threat to people as they could be struck by flying debris, falling trees/branches, utility lines, and poles. First responders could also not be able to respond to calls due to blocked roads. Tornadoes commonly cause power outages which could cause health and safety risks to faculty and students at schools, as well as to patients in hospitals.

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Tornadoes have the potential to pose a significant risk to the population and can create dangerous situations. Individuals who are exposed to the storm can be struck by flying debris, falling limbs, or downed trees. Residential structures can be damaged or crushed by falling trees, which can result in physical harm to the occupants. Large amounts of debris on the roadways, such as downed trees, can result in emergency response vehicles being unable to access areas of the City planning area. Additionally, downed power lines that are still energized are extremely dangerous and may result in roadways being unsafe for use, which may prevent first responders from responding to calls for assistance or rescue.

In addition to the potential impacts faced by the general public, response personnel must enter the damage area shortly after the tornado passes to begin rescue operations and to organize cleanup and assessment efforts. During these efforts, response personnel are exposed to downed power lines, unstable and unusual debris, hazardous materials, and generally unsafe conditions.

Tornadoes often result in power outages over widespread areas. If generators are not available, those individuals who rely on power for health and/or life safety, such as those on life support systems, could be placed in jeopardy. Also, extended power outage can result in an increase in structure fires and/or carbon monoxide poisoning, as individuals use alternate, unsafe cooking or heating devices, such as grills, to attempt to cook or heat their home. Tornadoes can destroy or make residential structures uninhabitable, requiring shelter or relocation of residents in the aftermath of the event.

Tornadoes are a threat to operations and service delivery in the City of Austin planning area and have the potential to significantly impact local government's continuity of operations. While the City of Austin Office of Homeland Security and Emergency Management has a protected facility from which to operate, roadway debris or other obstructions may prevent the staff from accessing the facility. Staff members unable to access the protected facility would be limited to performing work with the resources that were accessible to them from their remote location.

Other City departments may not be as protected as the City of Austin HSEM and may suffer more interruptions as a result of damages from tornadoes. If files (hard or electronic) are damaged, destroyed, or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City and could negatively impact its ability to respond to and recover from the tornado event. Without a plan that takes into account department-specific issues, or regular exercise of that plan, critical departments may not be able to function and provide necessary services.

Additionally, private sector entities that the City and its residents rely on, such as utility providers, financial institutions, and medical care providers should have specific plans that are routinely exercised. For example, if debris produced by tornadoes resulted in the closure of roadways over a large area, this would result in a temporary halt to any repair of damaged infrastructure; impede emergency response activities, and interruption in the normal delivery of goods and services.

The Austin Independent School District is also at risk from damages from tornadoes. Damages to the district's building or power outages could make the schools unsafe for students to attend. AISD will also have to consider the safety of the students during transportation to and from the schools, especially if widespread road closures result from the debris produced by tornadoes.

Damaged electrical substations, downed power lines, and roadway obstructions are common occurrences after tornadoes, and all of these will impact the City's normal operations and service delivery. It is imperative that both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed.

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Tornadoes typically damage the infrastructure of a community, including buildings, facilities, roads, bridges, power lines, and power plants. It can take a significant amount of time to fully repair these facilities and infrastructure, depending on the nature of the damage and the availability of resources dedicated to the project. Damage to infrastructure will generally slow down the economic recovery of the community, as it often slows the re-opening of businesses and can limit the clean-up effort. There are some businesses that are more reliant on utility infrastructure than others. Grocery stores, for example, are typically reliant on electricity to maintain the safety of their food supply. Some larger chains may have emergency power generators and fuel on hand, but smaller, independent stores often do not. Some businesses may be forced to close temporarily, even those that were not directly impacted by the event, and for some businesses, loss of infrastructure can result in the failure of their business.

Tornadoes are a natural phenomenon and are unlikely to result in catastrophic or prolonged natural or environmental damage. However, the effects of tornadoes do pose a risk on the built environment, as damages to the built environment may result in both catastrophic and prolonged damage. For example, a chemical facility that is damaged by a tornado and leaks hazardous or dangerous chemicals into the environment could pose a significant and long-term risk. Depending on what is affected, the living organisms that rely directly and in-directly on that environment for health and survival may also be affected. Some harmful materials may take years, decades, or longer to become harmless and some materials may never fully break down. Until the chemicals break down into harmless products, they can continue to degrade the environment, and potentially leach into a water course or ground water, thus spreading contamination away from the site. Without clean-up, this may continue for years.

The potential financial and economic risks associated with tornadoes may be significant for the City of Austin planning area. While an individual residential structure that is damaged by a tornado can be devastating to the residents, the damage and cost of repair has a negligible impact on the community's overall economic health. However, a major tornado, where a large number of structures are damaged or destroyed, can have serious economic and financial consequences for a community.

The City of Austin planning area is home to a large number of cultural and historic resources. These resources are a significant draw for tourists and visitors to the area, and help to generate revenue through taxes and fees. This revenue pays for services and programs, which benefit residents and the community. The destruction of a tornado may negatively impact these revenues as tourists and visitors may not be allowed to visit these historical sites while response and recovery is ongoing.

Large or intense tornadoes can cause significant property damage, to homes, businesses, industrial properties, and government buildings, resulting in significant economic impact on the affected area. A community affected by significant property damage would need to now fund unforeseen and unbudgeted infrastructure repair and restoration, temporary services and facilities, debris removal, overtime pay for responders and local government staff, additional personnel and normal day-to-day operating expenses. While there are often state and federal programs that can help with these expenses, the majority of these programs are reimbursement programs, meaning that the local government must still fund the initial expenses out of pocket. Even with the best financial planning and management, unanticipated expenses will have an impact on the financial condition of a municipality or school district.

Large or intense tornadoes can also result in dramatic population fluctuations, as people are unable to return to their homes or jobs and must seek shelter and/or work outside of the affected area. They may require temporary relocation assistance, and some of them may choose not to return to the

## Section 11: Tornado

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community. Businesses that are uninsured or underinsured may have difficulty reopening, which results in a net loss of jobs for the community. A loss of jobs affects the financial and economic health and stability of the community and may result in an increase in the unemployment rate.

The economic and financial impacts of a tornado in the City of Austin planning area will depend on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and planning, including continuity planning that is accomplished by the City, businesses, residents, and AISD will contribute to the overall economic and financial conditions after a tornado.

Overall, the average loss estimate of property and crop (in 2015 dollars) is \$715,680,997, having an approximate annual loss estimate of \$11,732,475. Based on historic loss estimates, the impact of tornado damages on the City of Austin, including the AISD, can be considered “Major,” with more than 25 percent of property destroyed or with major damage, injuries and illnesses resulting in permanent disability, and critical facilities shut down for at least 2 weeks.

# Section 12: Expansive Soils

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## Hazard Description

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Expansive soils are soils and soft rocks with a relatively high percentage of clay minerals that are subject to changes in volume as they swell and shrink with changing moisture conditions. Drought conditions can cause soils to contract in response to a loss of soil moisture.

Expansive soils contain minerals such as smectite clays that are capable of absorbing water. When these clays absorb water they increase in volume and expand. Expansions in soil of ten percent or more are not uncommon in the City of Austin and AISD planning area. The change in soil volume and resulting expansion can exert enough force on a building or other structure to cause damage.



Expansive soils will also lose volume and shrink when they dry. A reduction in soil volume can affect the support to buildings or other structures and result in damaging soil subsidence. Fissures in the soil can also develop and facilitate the deep penetration of water when moist conditions or runoff occurs. This produces a cycle of shrinkage and swelling that places repetitive stress on structures.

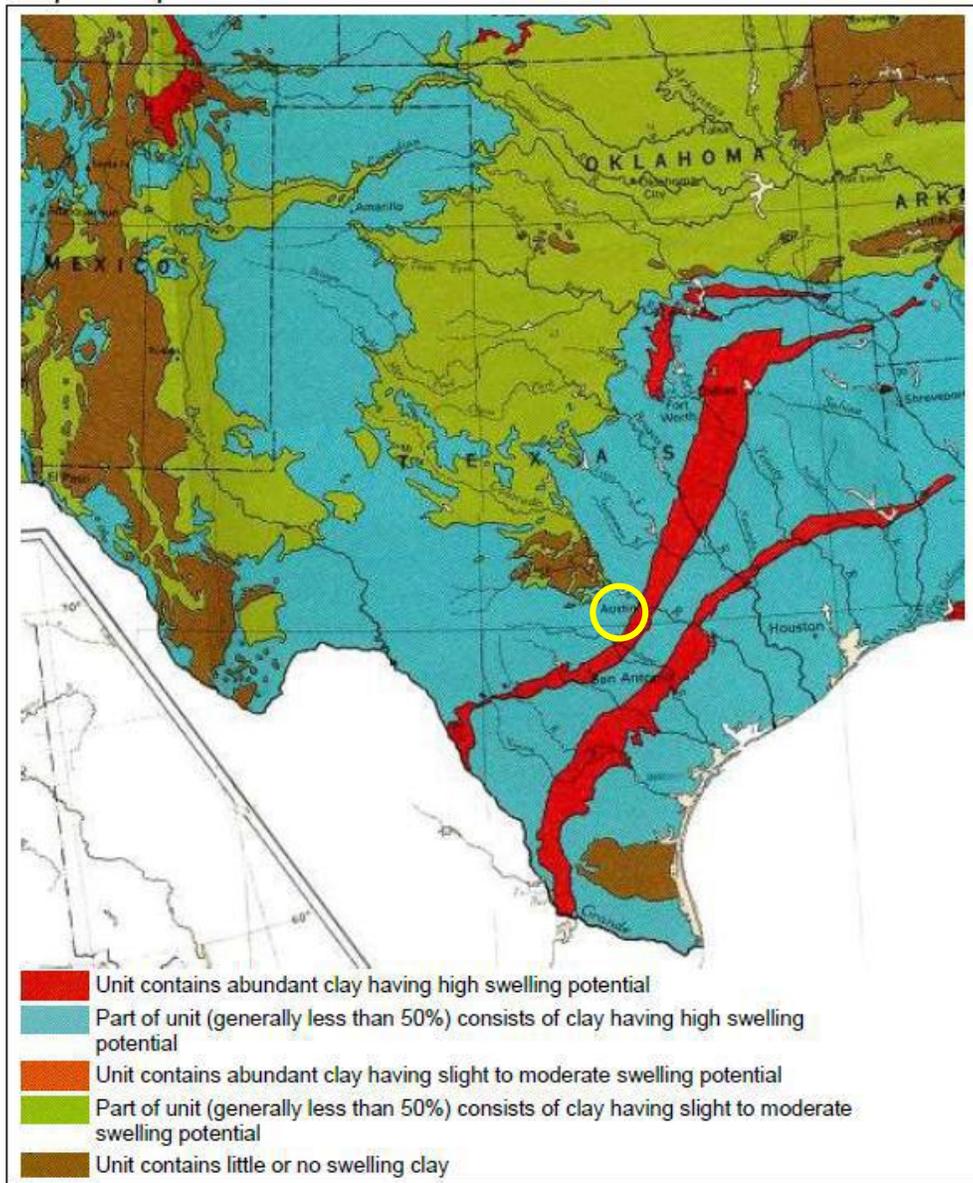
## Location

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The City of Austin and AISD planning area may be affected by the band of expansive soils stretching from northeast Dallas, southwest through San Antonio, towards Laredo, and along an area also known as the I-35 corridor, Figure 12-1 depicts expansive soils across the State of Texas and the City of Austin and AISD planning area is identified within the yellow circle. These areas receive the most moisture and are also vulnerable to droughts, which can cause the soils to expand and contract. Figure 12-2 depicts the types of land resources in the State of Texas due to their soil types.

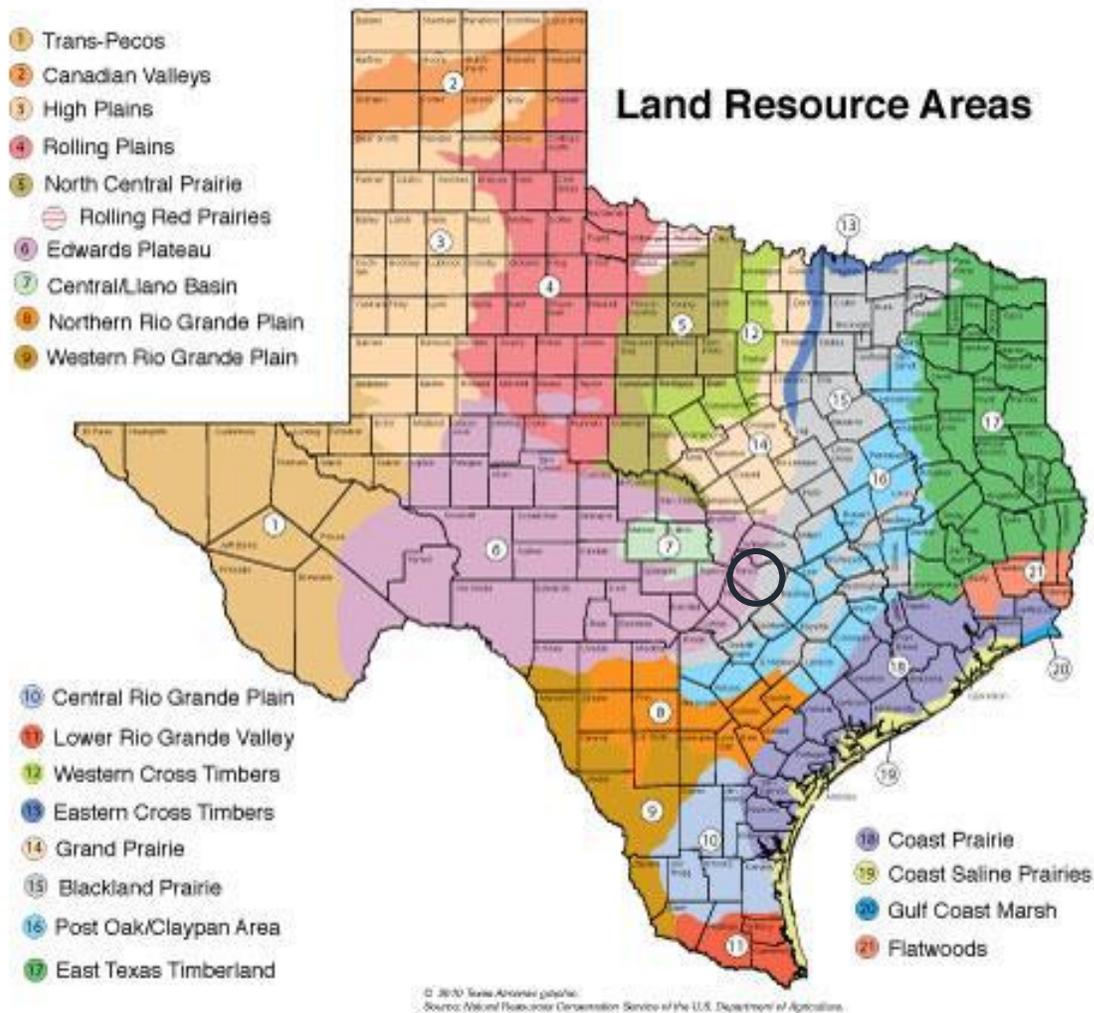
## Section 12: Expansive Soils

Figure 12-1. Texas Geological Survey<sup>1</sup>



<sup>1</sup> Source: United States Geological Survey, <http://www.usgs.gov>

Figure 12-2. Texas Geological Survey



The City of Austin, including AISD, is located within the Edwards Plateau and Blackland Prairie as identified within the black circle in Figure 12-2. The entire planning area, including AISD facilities is located in an area affected by expansive soils.

*Edwards Plateau:* The 22.7 million acres of the Edwards Plateau are in South Central Texas east of the Trans-Pecos and west of the Blackland Prairie. Uplands are nearly level to undulating, except near large stream valleys, where the landscape is hilly with deep canyons and steep slopes. There are many cedar brakes in this area and surface drainage is rapid.

Upland soils are mostly shallow, stony, or gravelly, and consisting of dark alkaline clays and clay loams underlain by limestone. Lighter-colored soils are on steep sideslopes and deep, less-stony soils are in the valleys. Bottomland soils are mostly deep, dark-gray or brown, with alkaline loams and clays.

Raising beef cattle is the main enterprise in this region, but it is also the center of Texas' and the nation's mohair and wool production. The area provides a major deer habitat, and hunting leases

## Section 12: Expansive Soils

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produce income. Cropland is mostly in the valleys on the deeper soils and is used mainly for growing forage crops and hay. The major soil-management concerns are brush control, large stones, low fertility, excess lime, and limited soil moisture.

*Blackland Prairie:* The Blackland Prairies consist of about 12.6 million acres of east-central Texas extending southwesterly from the Red River to Bexar County. There are smaller areas to the southeast. The landscape is undulating with few scattered wooded areas that are mostly in the bottomlands. Surface drainage is moderate to rapid.

Both upland and bottomland soils are deep, dark-gray to black, and consist of alkaline clays. Some soils in the western part are shallow to moderately deep over chalk. Soils on the eastern edge are typically neutral to slightly acidic, grayish clays and loams over mottled clay subsoils (sometimes called graylands). Blackland soils are known as “cracking clays” because of their high shrink-swell property and large, deep cracks that form in dry weather. The high shrink-swell property can cause serious damage to foundations, highways, and other structures; and is a safety hazard in pits and trenches.

Land use is almost equally cropland and grassland. Cotton, grain sorghums, corn, wheat, oats, and hay are grown in this area. Grassland is mostly improved pastures, with native range on the shallower and steeper soils. Water erosion, cotton root rot, soil tilth, and brush control are the major management problems.

### Extent

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The extent to which soil expansion is present in an area can be measured using the standard test method for expansive soils which has been adopted by the American Society for Testing and Materials (ASTM D-4829).<sup>2</sup> The expansion index (EI) provides an indication of swelling potential for a compacted soil.<sup>3</sup> The EI measures volumetric swelling and is calculated by bringing a soil sample to 50 percent saturation and the multiplying the percentage of soil swelling with the fraction of soil to pass through a No. 4 sieve, and then by 100.

**Table 12-1. Swelling Potential of Soils and Plasticity Index**

Potential Expansion	Expansion Index
Low	0 – 15
Medium	10 – 35
High	20 – 55
Very High	35 and above

The amount and depth of potential swelling that can occur in a clay material are, to some extent, functions of the cyclical moisture content in the soil. In dryer climates where the moisture content in the soil near the ground surface is low because of evaporation, there is a greater potential for extensive swelling than the same soil in wetter climates where the variations of moisture content are not as

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<sup>2</sup> <http://www.astm.org/Standards/D4829.htm>

<sup>3</sup> [http://publicecodes.cyberregs.com/icod/ibc/2009f2cc/icod\\_ibc\\_2009f2cc\\_18\\_par012.htm](http://publicecodes.cyberregs.com/icod/ibc/2009f2cc/icod_ibc_2009f2cc_18_par012.htm)

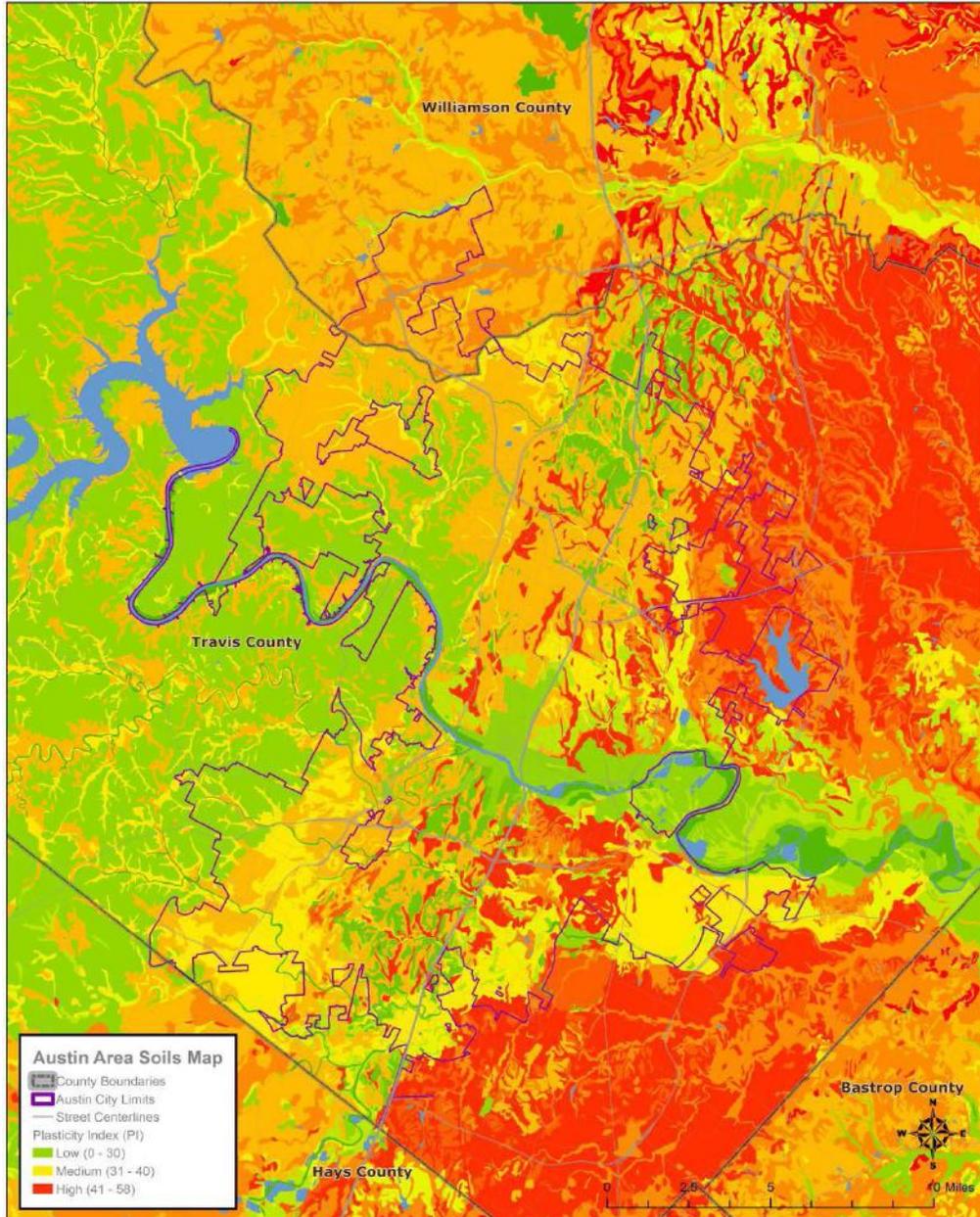
## Section 12: Expansive Soils

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severe. Volume changes in highly expansive soils range between seven and ten percent, however under abnormal conditions, they can reach as high as 25 percent.

The Web Soil Survey is used to measure the extent of expansive soils by measuring the type of soils and their moisture content. Figure 12-3 depicts the plasticity index of the soils in the City of Austin and AISD planning area. Note, that AISD Schools are all located within the purple boundary on the map provided in Figure 12-3.

Figure 12-3. Plasticity Index of Austin Area Soils <sup>4</sup>



The red and orange areas shown in Figure 12-3 indicate locations with relatively higher plasticity soils, which can exhibit greater sensitivity to drought conditions. High plasticity soils are prone to shrink and swell as soil moisture changes, which can degrade pavement, causing longitudinal cracking and edge drop-off. This effect can damage foundations of buildings and homes. AISD facilities are subject to a range of plasticity Index levels including low, medium and high, as indicated by the soils in map in Figure 12-3 above.

<sup>4</sup> Source: National Cooperative Soil Survey

### Historical Occurrences

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Expansive soils is a condition that is native to Texas soil characteristics, and cannot be documented as a time-specific event, except when it leads to structural and infrastructure damage.

The photos below represent the types of longitudinal cracking damage that expansive soils have caused in the planning area. All of the pictures feature relatively new roads that were damaged, in part, by changes in soil moisture. Roads in the City of Austin have been damaged to expansive soils in 2008, 2009, and in the summer of 2011, according to the Capital Area Metropolitan Planning Organization Risk Assessment.<sup>5</sup>

Extreme conditions can damage new roads, including projects still under construction. The Texas State Highway (SH) 130 tollway, under construction in 2011 in neighboring Caldwell County, suffered an estimated \$30 million in damage from cracks across several sections. In response, builders repaired cracks and also changed the substructure to create moisture barriers designed to mitigate soil moisture-related damage in the future.



Left: Photo of pavement cracks in a new Austin subdivision in 2009. Right: Longitudinal cracking on Golden Falls Drive in Travis County in 2008. Photo credit: City of Austin.



Photo of a severe pavement crack on Hamann Lane in Travis County in 2005. Photo credit: City of Austin.

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<sup>5</sup> Source: CAMPO Extreme Weather Vulnerability Assessment

## Section 12: Expansive Soils

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It is important to note that because AISD includes schools and facilities within the city of Austin planning area, there may be some occurrences that have occurred for the AISD and may not have been recorded. During the planning process, AISD has reported that there is no record of an event occurrence for this hazard.

### Probability of Future Events

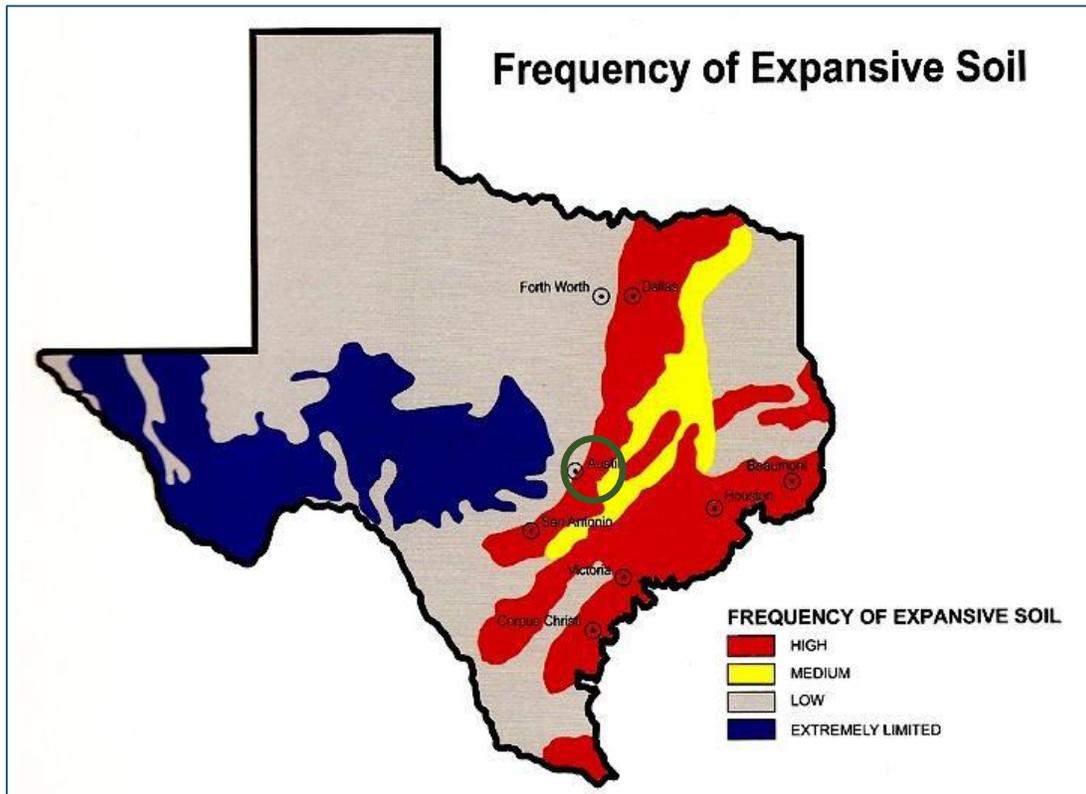
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According to the CAMPO Extreme Weather Vulnerability Assessment, the MetroRail Red Line at Boggy Creek may have a high sensitivity to drought. This rating is based on the soil plasticity near the asset. The Red Line is built over some of the most expansive soils in the region, with a soil plasticity index of 55 on a scale of 0 to 58 (See Figure 12-3). This high plasticity indicates that soils could expand and contract dramatically with changes in soil moisture, and in turn damage infrastructure.

Since no other records of specific incidences of loss associated with expansive soils were found, and no specific occurrences of expansive soils were identified within the planning area, the probability of future events cannot be determined at this time. However, according to public opinion, the probability of future events of loss due to expansive soils within the planning area, is highly possible, especially when periods of drought increase throughout the planning area.

Figure 12-4 displays the frequency of expansive soil occurrences for the entire state. The City of Austin and AISD planning area is shown in the green circle and are both subject to a range of frequency of expansive soils with a maximum "High" frequency.

Figure 12-4. Frequency of Expansive Soil



## Vulnerability and Impact

The effects of expansive soils are most prevalent when periods of moderate to high precipitation are followed by drought and then again by periods of rainfall. Other cases of damage result from increases in moisture volume from such sources as broken or leaking water and sewer lines. Dry clays are capable of absorbing water and will increase in volume in an amount proportional to the amount of water absorbed. Soils capable of changes in volume present a hazard to structures built over them and to the pipelines buried in them. Houses and one-story commercial buildings are more apt to be damaged by the expansion of swelling clays than are multi-story buildings, which are usually heavy enough to counter swelling pressures. However, if constructed on wet clay, multi-story buildings may also be damaged by clay shrinkage when moisture levels are substantially reduced.



Cracked foundations and floors, jammed windows and doors, and ruptured pipelines are typical types of damage resulting from swelling soils. Damage to the upper floors of larger buildings can occur when motion in the structure is significant. All infrastructure within in the planning area, including AISD schools, are susceptible to this phenomena.

## Section 12: Expansive Soils

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The impact of expansive soils ranges from cosmetic cracks in walls to substantial foundation and structural damage that can result in a need for building demolition. Infrastructure such as pipelines can be damaged, causing increased maintenance and repairs, replacement, or damage to the point of failure. Sewer and water lines are also affected by shrink and swell soils. The movement of the soils can snap water and sewer lines, producing a minimum of temporary discomfort, and a maximum of a serious health and welfare risk.

Homeowners and public agencies that assume they cannot afford preventative measures such as more costly foundations and floor systems, often incur the largest percentage of damage and costly repairs from expanding soil. No figures are available for the total damage to homes in the planning area from expansive clays. However, several examples are known where the cost of repairs has exceeded the value of homes. Additionally, in some areas of Austin, streets and highways have required frequent and very expensive reconstruction or maintenance due to damage from expansive clay.

For the City of Austin and AISD, the most extensive damage from expansive soils can occur to bridges, highways, streets, and parking lots. The greatest damage occurs when structures are constructed when clays are dry (such as during a drought) and then subsequent soaking rains swell the clay.

The AISD is comprised of 142 facilities including school campuses and support facilities such as administrative, athletics, transportation and support facilities. While expansive soils can impact all facilities within the AISD, older slab on grade structures built to less stringent codes, parking lots and walkways are at greater risk. The AISD could be impacted by having displaced students if buildings were to be damaged, and the financial burden could be high.

# Section 13: Winter Storm

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## Hazard Description

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Winter storms can cause significant problems for area residents. A severe winter storm event is identified as a storm with snow, and ice or freezing rain. Winter storms are associated with freezing or frozen precipitation such as freezing rain, sleet, snow and the combined effects of winter precipitation and strong winds. Wind chill is a function of temperature and wind. Low wind chill is a product of high winds and freezing temperatures.

Winter storms that threaten the City of Austin and the Austin Independent School District (AISD) planning area usually begin as powerful cold fronts that push south from central Canada. Although the City of Austin, including AISD, is at risk to ice hazards, snow, and extremely cold temperatures, the effects and frequency of winter storm events are generally mild and short-lived.



Source: <http://kxan.com/blog/2014/11/12/today-is-texas-winter-weather-awareness-day/>

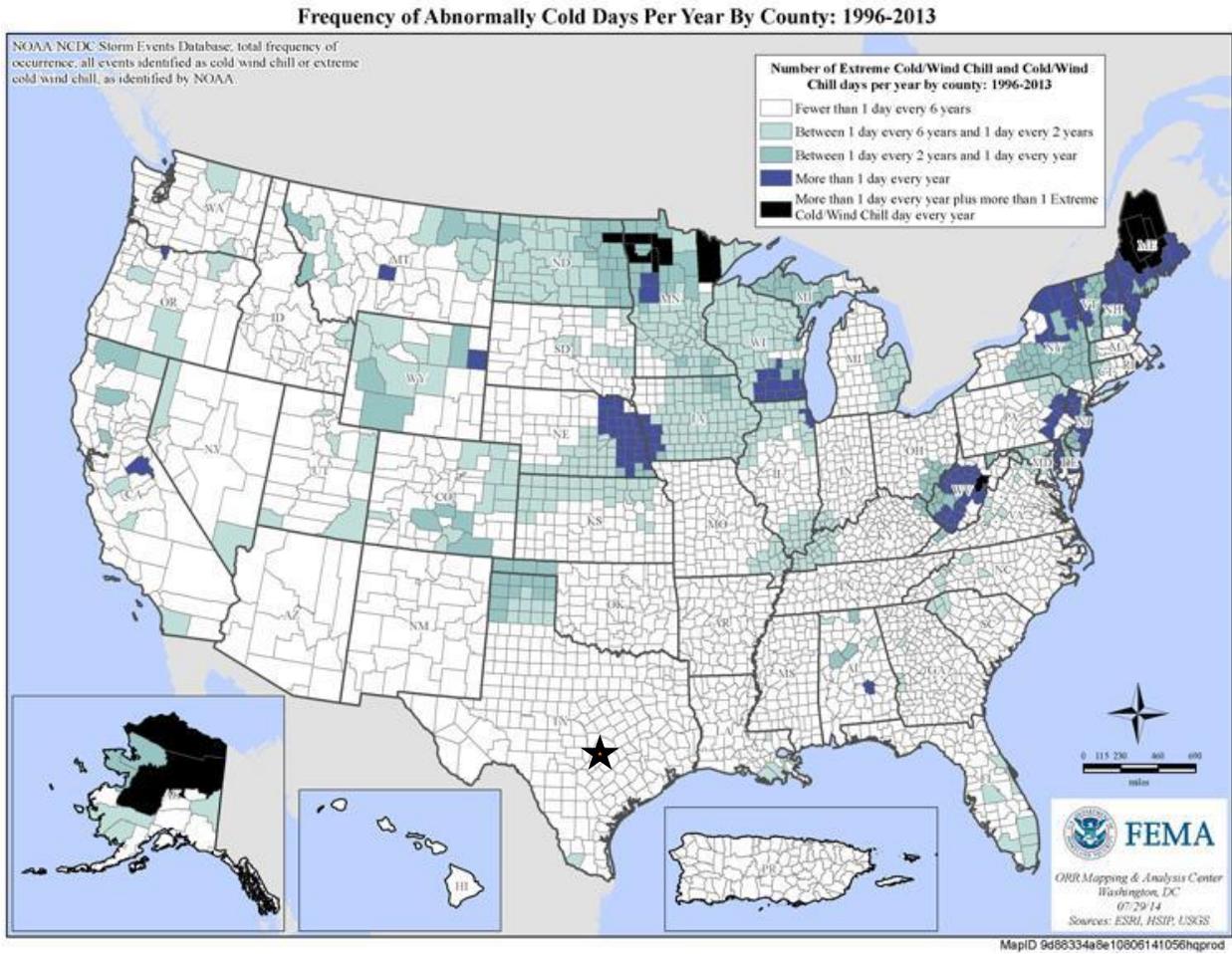
Data from the National Oceanic and Atmospheric Administration (NOAA) and National Climatic Data Center (NCDC) Storm Events Database shows the total frequency of occurrence of all events identified as blizzards, heavy snow, ice storm, lake-effect snow, and winter storm or winter weather. As indicated in Figure 13-1, on average, the City of Austin and AISD planning area experiences less than one extreme cold day every six years. Figure 13-2 indicates that on average, the planning area experiences one or fewer of the listed winter storm types per year.<sup>1</sup> Figure 13-3 indicates that the planning area could expect a snow accumulation of 0.1-3.0 inches a year. During times of ice and snow accumulation, public safety response times can increase until major roads become passable.

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<sup>1</sup> <http://community.fema.gov/hazard/winter-storm/be-smart>

# Section 13: Winter Storm

## Figure 13-1. Extreme Cold Days, 1996-2013<sup>2</sup>



<sup>2</sup> The City of Austin indicated by star.

# Section 13: Winter Storm

## Figure 13-2. Frequency of Winter Storm Events, 1996-2013

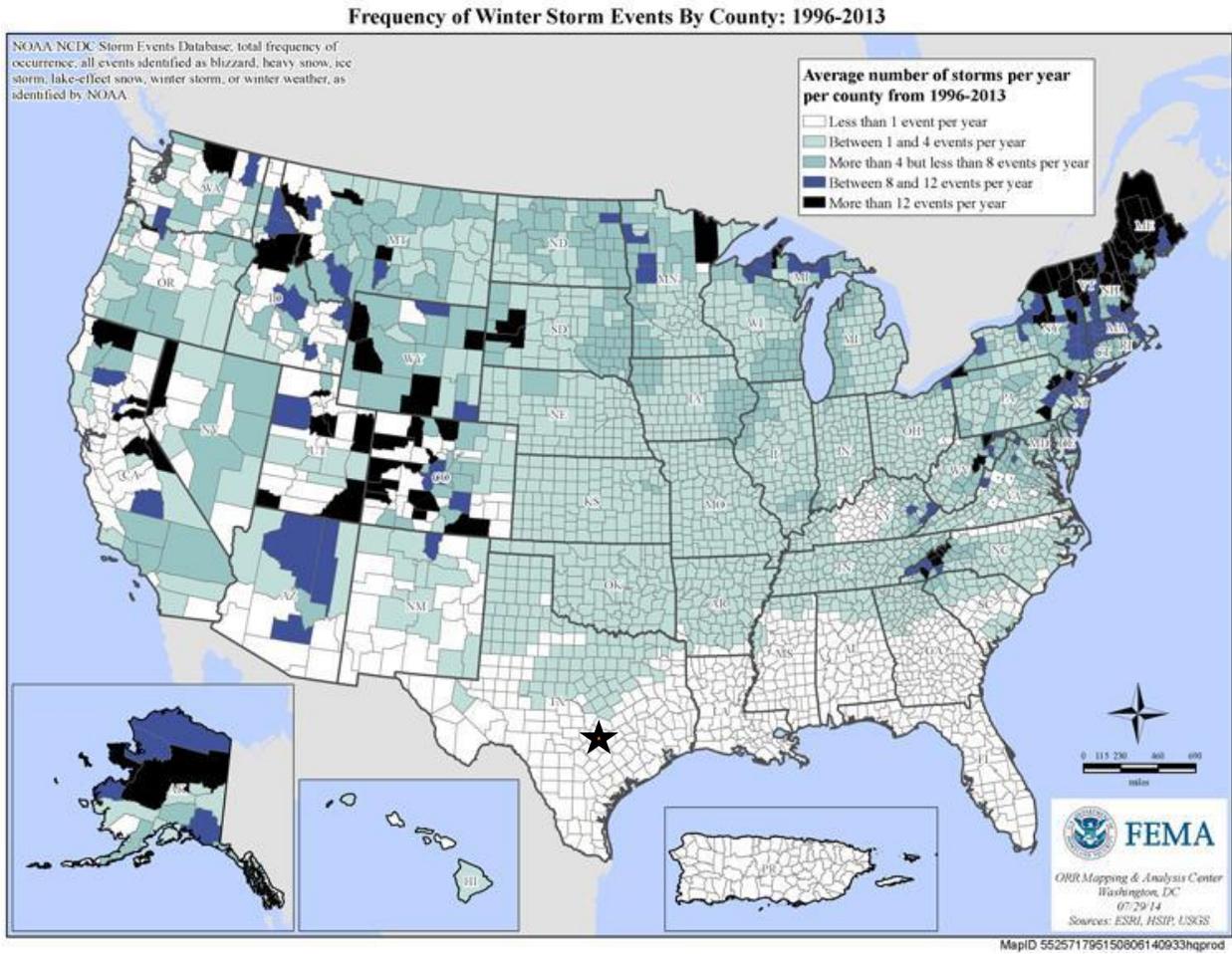


Figure 13-3. Annual Mean Snowfall for Texas

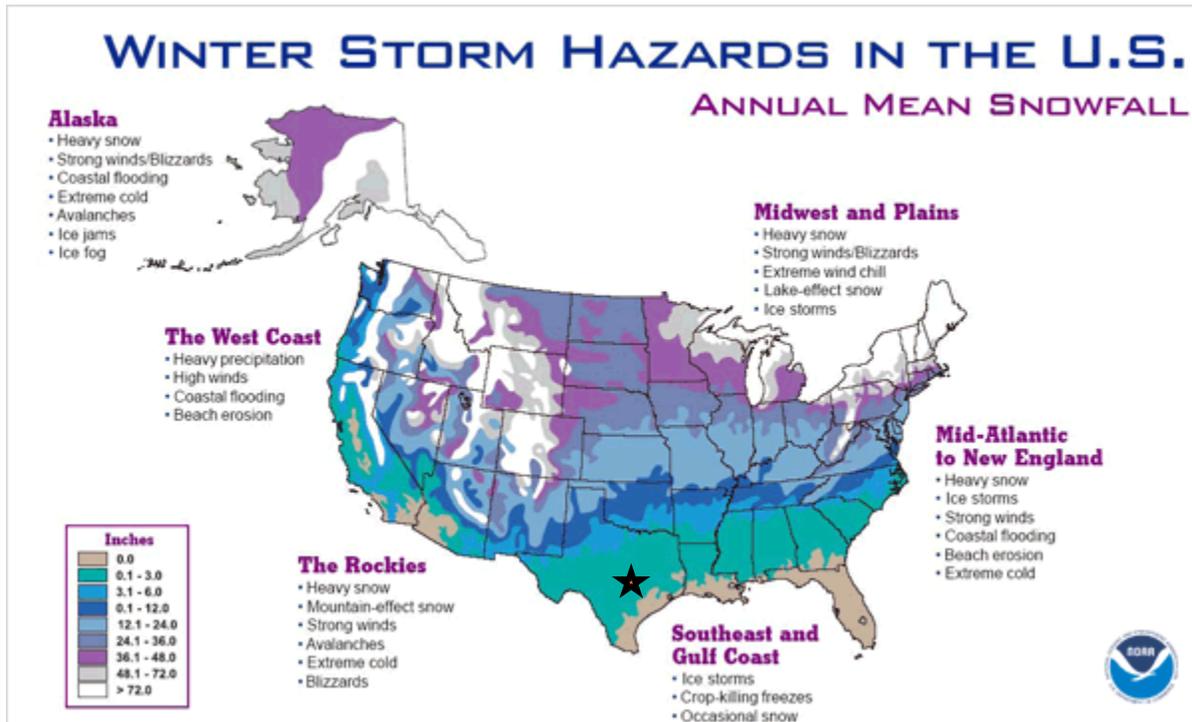


Table 13-1 describes the types of winter storms possible to occur in the City of Austin planning area.

## Section 13: Winter Storm

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**Table 13-1. Types of Winter Storms**

TYPE OF WINTER STORM	DESCRIPTION
<b>Winter Weather Advisory</b>	Weather advisories may be announced for snow, blowing or drifting snow, freezing drizzle, freezing rain, or a combination of weather events.
<b>Winter Storm Watch</b>	Severe winter weather conditions may include freezing rain, sleet or heavy snow, and conditions may occur separately or in combination.
<b>Winter Storm Warning</b>	Severe winter weather conditions are imminent.
<b>Freezing Rain or Freezing Drizzle</b>	Rain or drizzle is likely to freeze upon impact, resulting in a coating of ice glaze on roads and all other exposed objects.
<b>Sleet</b>	Small particles of ice usually mixed with rain. If enough sleet accumulates on the ground, it makes travel hazardous.
<b>Blizzard Warning</b>	Sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. These are the most perilous winter storm conditions with visibility dangerously restricted.
<b>Frost/Freeze Warning</b>	Below freezing temperatures are expected and may cause significant damage to plants, crops and fruit trees.
<b>Wind Chill</b>	A strong wind combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50 degrees lower in a calm atmosphere. The combined cooling power of the wind and temperature on exposed flesh is called the wind-chill factor.

### Location

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Because winter storm events are not confined to specific geographic boundaries, all existing and future buildings, facilities, and populations within the City of Austin and AISD are considered to be exposed to this hazard and could potentially be impacted.

### Extent

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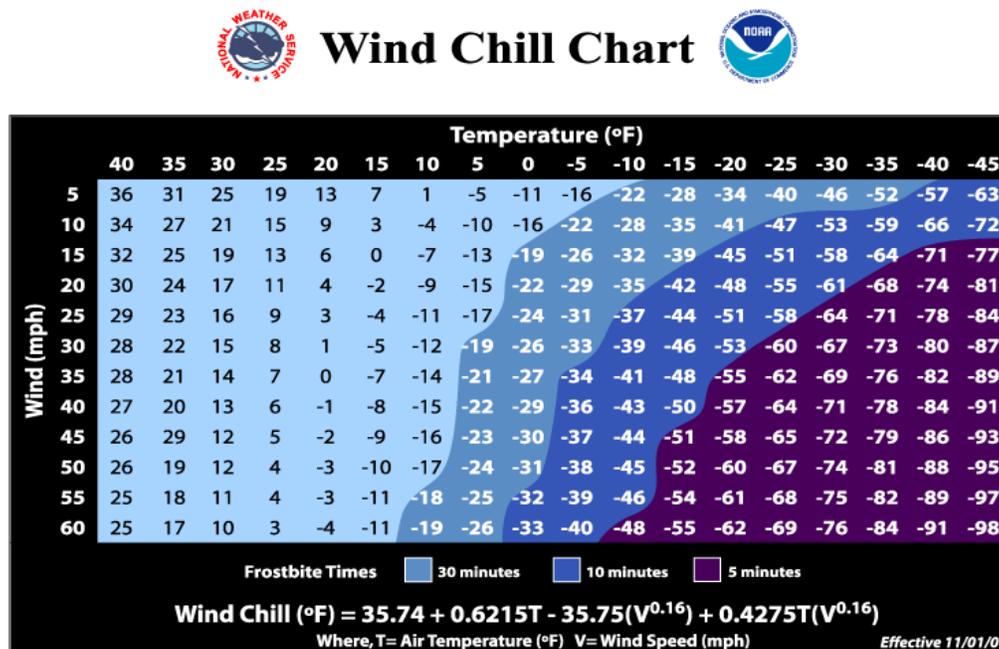
The extent or magnitude of severe winter storms is measured in intensity based on the temperature and level of accumulations as shown in Table 13-2. The intensity index was developed by the National Weather Service. Table 13-2 is not applicable when temperatures are over 50° or winds are calm, and can be read in conjunction with the wind chill factor described in Figure 13-4.

## Section 13: Winter Storm

**Table 13-2. Magnitude of Severe Winter Storms**

INTENSITY	TEMPERATURE RANGE	EXTENT DESCRIPTION
Mild	40° – 50°	Winds less than 10 mph and freezing rain or light snow falling for short durations with little or no accumulations.
Moderate	30° – 40°	Winds between 10 and 15 mph with sleet and snow up to 4 inches.
Significant	25° – 30°	Intense snow showers accompanied with strong gust winds, between 15 and 20 mph, and significant snow accumulation.
Extreme	20° – 25°	Wind driven snow that reduces visibility, heavy winds between 20 to 30 mph, and sleet or ice up to 5 millimeters in diameter.
Severe	Below 20°	Winds of 35 mph or more, and snow and sleet accumulation greater than 4 inches.

**Figure 13-4. Wind Chill Chart**



Wind chill temperature is a measure of how cold the wind makes real air temperature feel to the human body. Since wind can dramatically accelerate heat loss from the body, a blustery 30° day would feel just as cold as a calm day with 0° temperatures. The City of Austin and AISD have never experienced a blizzard, but based on 31 previous occurrences recorded from 1950 to 2014 for Travis County, it has been subject to winter storm watches, warnings, freezing rain, sleet, snow and wind chill.

## Section 13: Winter Storm

Based on the data for historical occurrences and the area where the City of Austin and AISD are located, the average event for the planning area to mitigate would be mild to moderate winter storm. The City of Austin planning area can expect anywhere between 0.1 to 3.0 inches of ice and snow during a winter storm event and temperatures between 30 and 50 degrees with winds ranging from 0 to 15 mph.

### Historical Occurrences

Table 13-3 shows the type and historical occurrence of winter storm events for Travis County from 1950 to 2014, provided by the NCDC and Spatial Hazard Events & Losses Database for the United States (SHELDUS) databases. There have been 31 recorded winter storm events in Travis County. Only winter storm events that have been reported have been factored into this Risk Assessment. It is likely that additional winter storm occurrences have gone unreported before and during the recording period. Historical winter storm information, as provided by the NCDC and SHELDUS, shows winter storm activity across a multi-county forecast area for each event, the appropriate percentage of the total property and crop damage reported for the entire forecast area has been allocated to each county impacted by the event. The NCDC and SHELDUS databases do not break down data by city for winter storm events; therefore, data for the City of Austin and AISD are incorporated into the historical data listed below. Table 13-3 shows historical incident information for the planning area which resulted in property, or crop damage.

**Table 13-3. Historical Winter Storm Events, 1950-2014**

DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
1/9/1962	0	0	\$19,686	\$19,686	\$152,339	\$152,339
12/10/1972	0	0	\$197	\$0	\$1,100	\$0
1/8/1973	0	0	\$1,969	\$196,850	\$10,362	\$1,036,156
3/2/1980	0	0	\$0	\$53,191	\$0	\$150,864
3/18/1980	0	0	\$0	\$5,319	\$0	\$15,086
4/14/1980	0	0	\$0	\$5,319	\$0	\$15,086
1/10/1982	0	0	\$31,250	\$31,250	\$75,682	\$75,682
1/11/1982	0	0	\$31,250	\$0	\$75,682	\$0
1/12/1985	0	0	\$7,246	\$0	\$15,739	\$0
3/29/1987	0	0	\$0	\$35,971	\$74,003	\$0
2/4/1989	1	0	\$5,682	\$5,682	\$10,709	\$10,709
12/22/1989	1	0	\$1,612,903	\$1,612,903	\$3,039,893	\$3,039,893
2/1/1996	0	0	\$78,947	\$2,632	\$117,594	\$3,920

## Section 13: Winter Storm

DATE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
1/7/1997	0	0	\$500,000	\$10,000	\$728,059	\$14,561
1/11/1997	0	0	\$37,037	\$740,741	\$53,930	\$1,078,606
1/15/2007	0	0	\$1,600,000	\$0	\$1,803,451	\$0

Based on the list of historical winter storm events (listed above), 7 of the events occurred after the 2010 Plan Update. These events are from the date of February 2011 through November 2014. Below is a list of events that the AISD have on record for the period from the 2010 Plan Update through November 2014. It is important to note that the AISD schools and facilities are within the Travis County/City of Austin planning area. There may be some occurrences that have occurred for the AISD and may not have been recorded, but are included in this occurrence data because of their location.

**Table 13-4. Summary of Recorded Winter Storm Events for AISD, 2010-2015**

DATE	EVENT	SCHOOLS AFFECTED
2/10/2014	Winter Storm	All AISD Schools
1/18/2015	Winter Storm	All AISD Schools
2/23/2015	Winter Storm	All AISD Schools
3/4/2015	Winter Storm	All AISD Schools

### Significant Past Events

#### February 23, 2015 – City of Austin & AISD

A cold front brought below freezing temperatures and light precipitation. Precipitation was a mix of sleet and freezing drizzle. Sleet was first reported in Travis County and spread to Kerr and Williamson. There was some light icing on elevated surfaces.

#### March 4, 2015 – City of Austin & AISD

A cold front brought below freezing temperatures and light precipitation to parts of South Central Texas. There was a mix of freezing rain, sleet, and rain over our northern counties from Kerr to Williamson. There were reports of some icy spots on roads, bridges, overpasses, and elevated surfaces. There were also reports of ice in Bexar and Val Verde Counties. No roads were closed and no accidents were reported.

#### March 4, 2014 – City of Austin

In the wake of a strong cold front, a shallow layer of cold air settled over South Central Texas in March 2014. An upper level trough moved across the southern plains and caused elevated thunderstorms during the evening of March 3rd. Some of these storms produced small hail. Then an isentropic

## Section 13: Winter Storm

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uplift of warm moist air froze the precipitation during the early morning hours of the 4th. The first report of freezing rain occurred at 12:40am in Travis County. Icy bridges and overpasses were reported in Travis, Williamson, Fayette, and Caldwell Counties. In Fayette County, county offices and school openings were delayed on March 4th.

### **January 27, 2014 – City of Austin**

A cold front brought an arctic air mass to South Central Texas January 27th. An isentropic uplift of warm moist air over the cold surface air led to sleet and freezing rain across the area. The first reports of sleet were just before 9:30pm in Kerr and Williamson Counties. The winter precipitation spread as far as Bexar and Comal Counties by the morning of January 28th. Icy bridges and overpasses were reported from Georgetown to Jarrell, and in the Austin metro area. Several accidents were reported in Austin.

### **December 7, 2013 – City of Austin**

Light freezing drizzle was reported as early as 6:40 pm with little to no accumulation. Later in the evening the eastern half of the Travis County, mainly east of I-35, experienced an accumulation of freezing drizzle that produced icy spots on roads, bridges, and exposed surfaces. The Toll Road 130 on the east side, experienced icing as well as the Highway 183 area near the Austin Bergstrom Airport. A small area just north of the airport experienced a dusting of snow which led to a 25 car accident on Highway 183.

### **February 9, 2011 – City of Austin**

An arctic cold front brought winter weather to eastern sections of South Central Texas during the morning of February 9th. The precipitation was mainly freezing drizzle and rain and started in the north in Kerr and Llano counties with a few reports of icy roads before sunrise. The freezing rain spread southward and eventually affected much of the eastern half of South Central Texas. Although ice accumulations were light, they produced icy roads, bridges, and overpasses. Later in the morning there were some reports of snow in Travis, Williamson, and Gillespie counties with one inch reported in Fredericksburg.

## Probability of Future Events

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According to historical records, the City of Austin and AISD planning area experiences one winter storm event every one to two years. Hence, the probability of a future winter storm event affecting the City planning area is highly likely, with a winter storm likely to occur within the next year.

## Vulnerability and Impact

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The greatest risk from a winter storm hazard is to public health and safety. Exposure to cold temperatures, can cause serious or life-threatening health problems; particularly for infants and the elderly, who are less able to regulate body temperature than healthy adults. Anyone can be affected, but susceptible people, such as those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat can face dangerous situations due to extreme cold. Hypothermia and frostbite are the most common human health concerns associated with cold temperatures.

## Section 13: Winter Storm

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Students at Austin Independent School District are also susceptible as sporting events and practices are often held outside during late fall or early winter when temperatures begin to lower.

The U.S. Centers for Disease Control and Prevention has published a prevention guide for the public that combines key content of their CDC Winter Weather website and provides helpful advice and tips for preparing for and dealing with cold weather. The guide recommends that individuals gather and maintain the following cold weather supplies, in addition to food, water, and medicine for use in the event that the severe winter weather event lasts for more than a day or in the event that a loss of power lasts for an extended period:

- Alternate way to heat an area of the home, such as space heater with automatic shut-off;
- Blankets;
- Multi-purpose, dry chemical fire extinguisher;
- First aid kit;
- Flashlight or battery powered lantern;
- Battery powered radio and clock, with extra batteries;
- Non-electric can opener;
- Shovel and rock salt; and
- Any special needs items, such as medications and infant or elderly supplies.<sup>3</sup>

Response personnel are subject to the same impacts and risks as the general public. For a winter storm event, the risk to response personnel includes utility workers, public works personnel, debris removal staff, tow truck operators, and any other group responding to the effects of the severe winter storm. Response personnel may experience a greater exposure to winter storm event hazards and impacts than the general population, as response personnel may work in the cold weather and winter precipitation conditions, and would be required to travel in potentially hazardous conditions, while residents would be advised to stay indoors and off roadways. Responders may also encounter downed power lines, which are extremely dangerous if they are still energized.

Ice and snow can down trees and power lines, creating power outages for portions of the area. Excessive strain on the power grid can also result in failures of the system, making electricity unavailable to the normal customer base. Rolling blackouts, which are generally planned periodic outages to alleviate stress on the power grid, are also possible. Loss of electric power, normal sources of heat, or both can result in increased potential for health risks associated with fire injuries or hazardous gas inhalation. Extended power outage can result in an increase in structure fires and/or carbon monoxide poisoning, as individuals use alternate, unsafe cooking or heating devices, such as grills, to attempt to cook or heat their home. Electricity blackouts due to winter storm events may also negatively impact operations or service delivery. Lack of electricity, or interruptions in the delivery of electricity, can pose risks to service delivery and operations for agencies and departments that are unprepared for electricity interruptions and may not own emergency power generators.

The City of Austin Emergency Operations Center (EOC) has full emergency generator backup. Other City departments may not be as well-equipped as the EOC and may suffer more interruptions as a result of loss of power. If files (hard copy or electronic) are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the City and could negatively

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<sup>3</sup> Source: *Centers for Disease Control and Prevention: Extreme Cold: A Prevention Guide to Promote Your Personal Health and Safety*

## Section 13: Winter Storm

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impact its ability to respond to and recover from the winter storm. Without a Continuity of Operations Plan (COOP) that takes into account department-specific issues and considers how best to work around them, and without regular exercise of that COOP, critical departments may not be able to function, and may be unable to provide necessary services.

Private sector entities on which local government and its residents rely, such as utility providers, financial institutions, and medical care providers should have specific plans that are routinely exercised. For example, if blackouts result in a loss of power to medical centers, there could be dire consequences to patients and patient care, if no emergency power is available. It is imperative that both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed. Operations may also be impacted by limitations on access and mobility if roadways are closed, unsafe, or obstructed.

The Austin Independent School District is also at risk from winter storm events. Power outages at schools without emergency generators could make the schools unsafe for students to attend. The AISD will also have to consider the safety of the students during transportation to and from the schools, if roadways are closed, unsafe or obstructed. Additionally, the safety of the students who walk to school, or wait outside for a bus, will need to be taken into consideration due to the extreme cold and winter precipitation that accompanies winter storm events.

While severe winter storms themselves tend to be rather short-lived events, their effects can linger long after the storm has passed. Ice that falls and coats facilities, utilities, and roadways will not melt until the sun comes out and temperature rises above freezing, which can create prolonged periods of utility outages and hazardous road conditions. Power loss from damaged lines will affect properties and facilities and may create hazardous conditions for those that occupy the facilities. Extended periods of extreme cold temperatures may cause water pipes to freeze and burst. Roadways and other infrastructure that are affected by ice and freezing temperatures will not be able to function normally until the temperatures rise to warmer levels and the ice melts.

The impact to infrastructure, particularly utilities, will likely be more severe if the winter storm is accompanied by high winds because the winds will cause additional breakage and downing of already compromised power lines. Depending on the severity and scale of damage caused by ice and snow events, damage to power transmission and distribution infrastructure can require days or weeks to repair.

There are potential impacts to the environment, such as wildlife and native plant and tree species that are unaccustomed to living in colder temperatures. However, risks to wildlife would be mild because winter storm events tend to be of a short duration in the area. The plant species that are native to the area are not accustomed to severe cold weather for an extended period of time; therefore, a winter storm event could lead to tree, shrub, and plant damage or death. Sever cold and ice could also damage agricultural crops.

The City of Austin planning area is home to a large number of cultural and historic resources. These resources are a significant draw for tourists and visitors to the area, and help to generate revenue through taxes and fees. This revenue pays for services and programs that benefit residents and the community. Should an interruption in tourism occur because of a severe winter storm, it is likely to be short lived and have a temporary impact on historic and cultural resources that depend on tourism for support. Historic and culturally significant structures could experience the same potential impacts as other property, including downed trees, possible roof or structural damage, and potential damage to paved areas and water pipes. Depending on the severity of these impacts, an interruption in tourism is possible.

## Section 13: Winter Storm

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An economic impact in the City of Austin planning area may occur due to increased consumption of heating fuel, which can lead to energy shortages and higher prices. House fires and resulting deaths tend to occur more frequently from increased and improper use of alternate heating sources. Fires during winter storms also present a greater danger because water supplies may freeze and impede firefighting efforts.

The economic and financial impacts of winter weather on the City of Austin, including AISD, will depend on the scale of the event, what is damaged, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by businesses, citizens, and the AISD will also contribute to the overall economic and financial conditions in the aftermath of a winter storm event. Cleanup and repair costs would impact local government and the private sector. However, cleanup and repair costs would likely be addressed with insurance coverage, available state and federal assistance, operating reserves, or all of the above.

Based on the level of risk and historical occurrences for winter storms in the City of Austin, including the AISD, there is a "limited" severity of impact for winter storm events in the planning area; meaning injuries and illnesses are treatable with first aid, facilities and services can be shut down for 24 hours or less, and less than 10 percent of property can be destroyed or experience major damage.

Overall, the average loss estimate of property and crop (in 2015 dollars) is \$11,751,449.24, having an approximate annual loss estimate of \$225,989. Loss estimates were based on 52 years of statistical data from the NCDC. Only winter storm events that have been reported have been factored into this Risk Assessment. It is likely that additional winter storm occurrences have gone unreported before and during the recording period. Table 13-5 shows the annualized losses based on historical incident information for the planning area which resulted in death, injury, property or crop damage.

**Table 13-5. Winter Storm Event Damage Totals, 1950-2014**

JURISDICTION	NUMBER OF EVENTS	PROPERTY DAMAGES	CROP DAMAGES	PROPERTY DAMAGES (2015 DOLLARS)	CROP DAMAGES (2015 DOLLARS)
Travis County	31	\$3,926,767	\$2,719,544	\$6,158,545	\$5,592,904
<b>TOTAL LOSSES:</b>		<b>\$6,645,711</b>		<b>\$11,751,449</b>	

# Section 14: Dam Failure

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Portions of the City of Austin Hazard Mitigation Plan Update are considered confidential and not for release to the public. The information in this section is covered under the Privacy Act of 1974 (5 U.S.C. Section 552a).

# Section 15: Hurricane Wind

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## Hazard Description

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According to the National Oceanic and Atmospheric Administration (NOAA), a hurricane is an intense tropical weather system of strong thunderstorms with well-defined surface circulation and maximum sustained winds of 74 mph or higher. In the Northern Hemisphere circulation of winds near the Earth's surface is counterclockwise.

Hurricanes often begin as tropical depressions that intensify into tropical storms when maximum sustained winds increase to between 35 – 64 knots (39 – 73 mph). At these wind speeds, the storm becomes more organized and circular in shape and begins to resemble a hurricane. Tropical storms resulting in high winds and heavy rainfall can be equally problematic without ever becoming a hurricane and can be dangerous to people and property, resulting in high winds and heavy rainfall, as Tropical Storm Hermine did for Travis and Williamson Counties in September 2010. Once sustained winds reach or exceed 74 mph, the storm becomes a hurricane. The intensity of a land falling hurricane is expressed in categories relating wind speeds to potential damage. Tropical storm-force winds are strong enough to be dangerous to those caught in them.



## Location

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The City of Austin and Austin Independent School District (AISD) planning area is located inland from the coast and is outside of the hurricane wind speed hazard areas. Thus, the City of Austin is in a low risk area for hurricane wind speeds of 90 miles per hour (mph) or less. However, the City of Austin, including the AISD, is susceptible to the indirect threats of a hurricane, including high winds and flooding. Additionally, the City of Austin has hosted coastal area residents who evacuate during hurricane events.

## Extent

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As a hurricane develops, the barometric pressure (measured in millibars or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National

## Section 15: Hurricane Wind

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Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane.

Hurricanes are categorized according to the strength and intensity of their winds using the Saffir-Simpson Hurricane Scale (Table 15-1). A Category 1 storm has the lowest wind speeds, while a Category 5 hurricane has the highest. However, a lower category storm can inflict greater damage than higher category storms depending on where they strike, the amount of storm surge, other weather they interact with, and how slow they move.

**Table 15-1. Extent Scale for Hurricanes<sup>1</sup>**

CATEGORY	MAXIMUM SUSTAINED WIND SPEED (Mph)	MINIMUM SURFACE PRESSURE (Millibars)	STORM SURGE (Feet)
1	74 – 95	Greater than 980	3 – 5
2	96 – 110	979 – 965	6 – 8
3	111 – 130	964 – 945	9 – 12
4	131 – 155	944 – 920	13 – 18
5	155 +	Less than 920	19+

Based on the historical storm tracks for hurricanes and the location of the City of Austin and AISD planning area, which is outside of the hurricane wind hazard area, the average extent to be mitigated is for a Category 1 storm for the planning area.

## Historical Occurrences

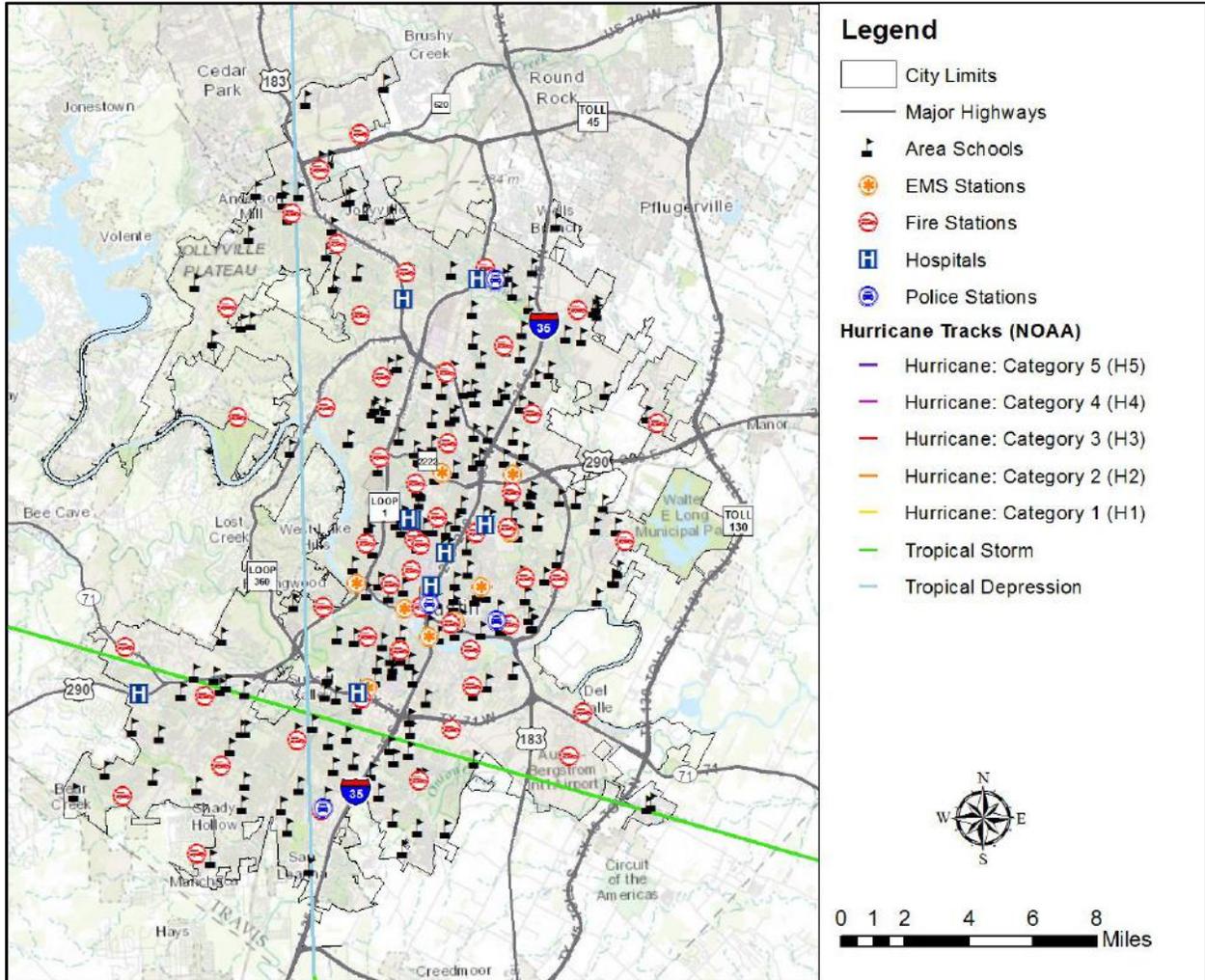
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By the time hurricanes and tropical storms have made landfall at various magnitudes (categories) in the City of Austin and AISD planning area, the storms have usually weakened to tropical storms or depressions, being near the end of their life cycle. With the storms having reduced winds, extreme rainfall is the hazard of concern. In Figure 15-1 below, hurricane tracks are reflective of their strength in the City of Austin and AISD planning area. Table 15-2 lists the storms that have tracked through the planning area. Historical hurricane data for Austin and AISD are provided on a County-wide basis per the National Climatic Data Center (NCDC), National Oceanic and Atmospheric Administration (NOAA), and Spatial Hazard Events & Losses Database for the United States (SHELDUS) databases.

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<sup>1</sup> Source: National Hurricane Center

Figure 15-1. Location of Historic Storm Tracks



## Section 15: Hurricane Wind

**Table 15-2. Historic Storms<sup>2</sup>**

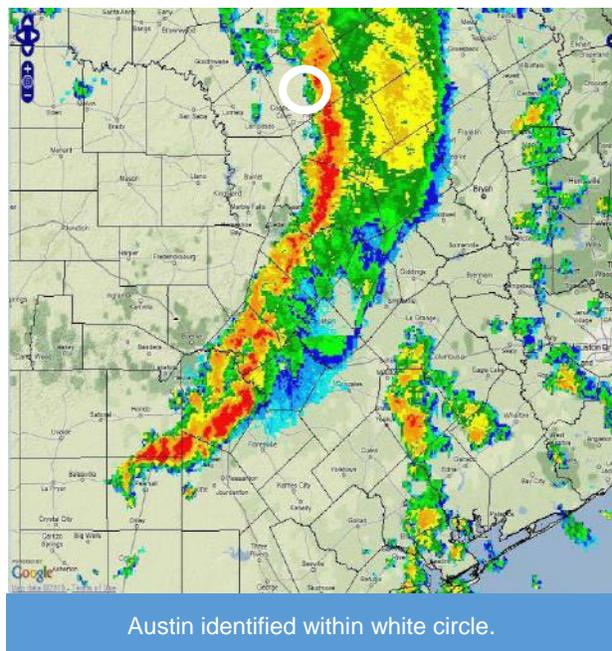
YEAR	STORM NAME	CATEGORY	PROPERTY DAMAGE	CROP DAMAGE	PROPERTY DAMAGE (2015 DOLLARS)	CROP DAMAGE (2015 DOLLARS)
1961	Carla	Category 4	\$505,051	505,051	3,947,620	3,947,620
1967	Beulah	Category 4	714,286	71,429	4,998,01	499,801
1968	Candy	Category 1	N/A	N/A	N/A	N/A
1970	Celia	Category 3	657,895	67,568	3,962,748	406,985
1971	Edith	Category 5	877	877	5,062	5,062
1973	Delia	Tropical Storm	N/A	N/A	N/A	N/A
1980	Allen	Category 5	5,319,150	531,915	15,086,439	1,508,644
2010	Hermine	Tropical Storm	N/A	N/A	N/A	N/A

Based on the list of historical hurricane wind events (listed above), only one event occurred after the 2010 Plan Update. This event was Tropical Storm Hermine and is explained in detail below. It is important to note that AISD schools and facilities are within the Travis County/City of Austin planning area. There may be some damages incurred for AISD and may not have been recorded, but are included in the City of Austin occurrence data because of their location.

### Significant Past Events

#### Tropical Storm Hermine, September 3-9, 2010 Travis County

On Tuesday afternoon an intense rain band developed primarily along the I-35 stretching several hundred miles from Waco to south of San Antonio due to tropical storm Hermine. Rain rates of 2-3 inches per hour were experienced in the Austin-San Antonio I-35 corridor and brought widespread flash flooding by Tuesday evening. Widespread rain totals of 5-6 inches were common along the corridor during the evening hours and the torrential rains continued over the next eight hours well past midnight early Wednesday morning. Camp Mabry in the City of Austin set a daily rainfall record on September 7, receiving 7.04 inches in a 24 hour period.<sup>3</sup>



<sup>2</sup> N/A means data was not available.

<sup>3</sup> The City of Austin indicated within the circle.

## Section 15: Hurricane Wind

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During the overnight hours early Wednesday September 8, tropical rains continued to fall across portions of Travis and Williamson Counties. The Shoal Creek and Brushy Creek watersheds were hit hardest. Several swift water rescues were performed as creeks overflowed their banks and flooded many low water crossings. The most intense rains of 10 - 16 inches occurred over the area from central Williamson County down into northern Travis County. A National Weather Service Cooperative Observer near Lake Georgetown recorded a total of 16.37 inches from September 7 - 9 with 14.57 inches of that total coming in a 24 hour time period. Shelters were set up as homes began to flood and RV parks were evacuated along Brushy Creek. For a time, I-35 in Georgetown was shut down with witnesses saying that water was as high as the center concrete barrier.

### Probability of Future Events

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Based on historical occurrences of significant hurricane wind events, the probability of future events is occasional, with a frequency of occurrence of one event every five years for the City of Austin and AISD.

### Vulnerability and Impact

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Hurricane-force winds can cause major damage to large areas; hence all existing buildings, facilities and populations are equally exposed and vulnerable to this hazard and could potentially be impacted. Most structures in the planning area can resist the effects of all but the most severe wind storms. The City of Austin area does have a number of mobile and manufactured home parks which are more vulnerable to hurricane winds than site built structures. If these homes were damaged or destroyed, these residents would be displaced. Similarly, AISD facilities are equally vulnerable to this hazard. The school district utilizes more than 630 portable buildings at their school campuses to facilitate shifts in school populations. These portable buildings would be more vulnerable to hurricane winds than the typical site built structures at each campus. If these portable buildings were damaged, the impact this would have on AISD is the students would be displaced and there are not enough hardened structures to house all of the school population.

Warning time for hurricanes has lengthened due to modern and early warning technology. Hurricane-force winds can easily destroy poorly constructed buildings and mobile homes; and debris such as signs, roofing materials, and small items left outside can become extremely hazardous in hurricanes and tropical storms. Extensive damage to trees, towers, and underground utility lines (from uprooted trees) and fallen poles can cause considerable civic disruption.

People whom are at risk due to rising waters may have to be evacuated; and shelters will be required for the influx of populations that have lost their homes. Those who are not evacuated can be exposed to flying debris, falling limbs, or downed trees from hurricane-force winds. Large amounts of debris on the roadways, such as downed trees, can result in emergency response vehicles being unable to access areas of the City planning area. Additionally, downed power lines that are still energized are extremely dangerous and may result in roadways being unsafe for use, which may prevent first responders from responding to calls for assistance or rescue.

The impact to infrastructure, particularly utilities, will likely be more severe when the outer bands of the hurricane is accompanied by high winds, because the winds will cause breakage and downing of power lines. Depending on the severity and scale of damage caused by hurricane-force winds, damage to power transmission and distribution infrastructure can require days or weeks to repair,

## Section 15: Hurricane Wind

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resulting in widespread power outages. If generators are not available, those individuals who rely on power for health and/or life safety, such as those on life support systems, could be placed in jeopardy. Also, extended power outages can result in an increase in structure fires and/or carbon monoxide poisoning, as individuals use alternate, unsafe cooking or heating devices, such as grills, to attempt to cook or heat their home.

Hurricane wind is a threat to operations and service delivery within the City planning area, and has the potential to significantly impact local government's continuity of operations. While the City of Austin Office of Homeland Security and Emergency Management has a protected facility from which to operate, roadway debris or other obstructions may prevent the staff from accessing the facility. Staff members unable to access the protected facility would be limited to performing work with the resources that were accessible to them from their remote location.

Other City departments may not be as protected as the City of Austin HSEM, and may suffer more interruptions as a result of damages from hurricane winds. If files (hard or electronic) are damaged, destroyed or otherwise inaccessible, a department may be unable to perform its assigned tasks and deliver its designated services. This interruption could have significant impacts throughout the area, and could negatively impact response recovery from the event. Without a plan that takes into account department-specific issues, or regular exercise of that plan, critical departments may not be able to function and provide necessary services.

Private sector entities on which local government and its residents rely, such as utility providers, financial institutions, and medical care providers should have specific plans that are routinely exercised. For example, if blackouts result in a loss of power to medical centers, there could be dire consequences to patients and patient care, if no emergency power is available. It is imperative that both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed. Operations may also be impacted by limitations on access and mobility if roadways are closed, unsafe, or obstructed.

The Austin Independent School District is also at risk for damages from hurricane-force winds. Damages to the district's buildings or power outages could make the schools unsafe for students to attend. The AISD will also have to consider the safety of the students during transportation to and from the schools, especially if widespread road closures result from downed debris.

Damaged electrical substations, downed power lines, and roadway obstructions are all common occurrences during hurricane wind events, and all of these will impact a community's normal operations and service delivery. It is imperative that the community, both public and private entities, plan for these events, and address how they will be able to function and provide services until normal operating conditions can be resumed.

The potential risks of hurricane wind to the area are not limited to property damages and loss of life; financial and economic risks associated with extreme winds may also be significant. While an individual residential structure that is damaged by wind can be devastating to the residents, it has a negligible impact on the community's overall economic health. However, a significant hurricane wind event, which damages or destroys a large number of structures, can have serious economic and financial consequences for a community.

Large scale wind events can cause significant property damage, to homes, businesses, industrial properties, and government buildings. This can have significant economic impact on the affected area, as it must now fund unforeseen and unbudgeted expenses such as infrastructure repair and restoration, temporary services and facilities, overtime pay for responders, as well as normal day-to-

## Section 15: Hurricane Wind

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day operating expenses. While there are often state and federal programs that can help with these expenses, the majority of these programs are reimbursement programs, meaning that the local government must still fund the initial expenses out of pocket.

Storm track data was available for the past 150 years; and property and crop loss data was available from 1950 to the present. Only hurricane wind events that have been reported have been factored into this Risk Assessment. It is likely that additional hurricane wind occurrences have gone unreported before and during the recording period. Table 15-3 shows the annualized losses based on historical incident information for the planning area which resulted in death, injury, property or crop damage. The average annual loss estimate for Travis County is approximately \$648,453.

**Table 15-3. Summary Historic Hurricane Events, 1950-2014**

<b>EVENTS</b>	<b>MAGNITUDE</b>	<b>DEATHS</b>	<b>INJURIES</b>	<b>PROPERTY DAMAGE (2015 DOLLARS)</b>	<b>CROP DAMAGE (2015 DOLLARS)</b>
<b>8</b>	<b>Category 5</b>	<b>11</b>	<b>1</b>	<b>\$27,999,880</b>	<b>\$6,368,111</b>
	<b>(max extent)</b>				
<b>TOTAL LOSSES:</b>				<b>34,367,992</b>	

The impact of hurricane wind events experienced in Travis County has resulted in 11 injuries and 1 fatality. Based on the level of risk and historical occurrences for hurricane winds in the City of Austin, including the AISD, there is a “minor” severity of impact for the City of Austin and AISD planning area; meaning injuries and illnesses do not result in permanent disability, the shutdown of facilities and services could be for 1 week or less, and more than ten percent of property can be destroyed or experience major damage.

# Section 16: Cyber-Attack

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Portions of the City of Austin Hazard Mitigation Plan Update are considered confidential and not for release to the public.

# Section 17: Technological Disruption

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## Hazard Description

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Technological disruptions can be caused by solar flares, geomagnetic storms, and power disruptions. A solar flare is a sudden, rapid, and intense flash of brightness observed over the sun's surface that occurs when built-up magnetic energy from the solar atmosphere is suddenly released. Flares generally cannot pass through the Earth's magnetosphere and atmosphere, therefore the City of Austin and Austin Independent School District (AISD) planning area is not vulnerable to powerful bursts of particles. However, solar flares can impact satellite and radio transmissions, cause flights to be re-routed due to changes in the Earth's magnetic field, and cause radio blackouts due to radiation.



Geomagnetic storms are a major disturbance of Earth's magnetosphere that occur when there is a very efficient exchange of energy from solar wind into the space environment surrounding the Earth. Magnetic storms can affect the performance of equipment, upset radio communications, blackout radars, and disrupt radio navigation systems.

## Location

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Space weather impacts various aspects of everyday life including a variety of phenomena that occur due to the variability of the sun over periods ranging from hours to years. A technological disruption can happen anywhere and at any time within the entire world, including the City of Austin and AISD planning area.

## Extent

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The National Oceanic and Atmospheric Administration (NOAA) Space Weather Scales were introduced as a way to publicly communicate the current and future space weather conditions and their possible effects on people and systems. Many of the Space Weather Prediction Center (SWPC) products describe the space environment, but few have described the effects that can be experienced as the result of environmental disturbances. The scales describe the environmental disturbances for three event types including geomagnetic storms, solar radiation storms, and radio blackouts. The scales have numbered levels, analogous to events that convey severity including hurricanes,

## Section 17: Technological Disruption

tornadoes, and earthquakes. The scales identify possible effects of an event, how frequently events occur, and the intensity of the physical causes.<sup>1</sup>

**Table 17-1. Geomagnetic Storms**

SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
<b>G 5</b>	<b>Extreme</b>	<p><b>Power systems:</b> Widespread voltage control problems and protective system problems can occur, and some grid systems may experience complete collapse or blackouts. Transformers may experience damage.</p> <p><b>Spacecraft operations:</b> Problems with extensive surface charging, and orientation, uplink/downlink, and tracking satellites can occur.</p> <p><b>Other systems:</b> Pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for one to two days, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).</p>	Kp = 9	4 per cycle (4 days per cycle)
<b>G 4</b>	<b>Severe</b>	<p><b>Power systems:</b> Possible widespread voltage control problems and some protective systems will mistakenly trip out key assets from the grid.</p> <p><b>Spacecraft operations:</b> Problems with surface charging and tracking can occur, and corrections may be needed for orientation problems.</p> <p><b>Other systems:</b> Induced pipeline currents can affect preventive measures, HF radio propagation is sporadic, satellite navigation degraded for hours, low-frequency radio navigation disrupted, and aurora has been seen as low as Alabama and northern California (typically 45° geomagnetic lat.).</p>	Kp = 8, including a 9	100 per cycle (60 days per cycle)

<sup>1</sup> <http://www.swpc.noaa.gov/noaa-scales-explanation>

## Section 17: Technological Disruption

SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
G 3	Strong	<p><b>Power systems:</b> Voltage corrections can be required, and false alarms triggered on some protection devices.</p> <p><b>Spacecraft operations:</b> Surface charging can occur on satellite components, drag can increase on low-Earth-orbit satellites, and corrections may be needed for orientation problems.</p> <p><b>Other systems:</b> Intermittent satellite navigation and low-frequency radio navigation problems can occur, HF radio can be intermittent, and aurora has been seen as low as Illinois and Oregon (typically 50° geomagnetic lat.).</p>	Kp = 7	200 per cycle (130 days per cycle)
G 2	Moderate	<p><b>Power systems:</b> High-latitude power systems can experience voltage alarms, and long-duration storms can cause transformer damage.</p> <p><b>Spacecraft operations:</b> Corrective actions to orientation can be required by ground control, and possible changes in drag can affect orbit predictions.</p> <p><b>Other systems:</b> HF radio propagation can fade at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 55° geomagnetic lat.).</p>	Kp = 6	600 per cycle (360 days per cycle)
G 1	Minor	<p><b>Power systems:</b> Weak power grid fluctuations can occur.</p> <p><b>Spacecraft operations:</b> Minor impact on satellite operations are possible.</p> <p><b>Other systems:</b> Migratory animals are affected, and aurora is commonly visible at high latitudes (northern Michigan and Maine).</p>	Kp = 5	1700 per cycle (900 days per cycle)

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**Table 17-2. Solar Radiation Storms**

SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE (Flux level of $\geq 10$ MeV particles)	AVERAGE FREQUENCY (1 Cycle = 11 Years)
S 5	Extreme	<p><b>Biological:</b> Unavoidable high radiation hazard to astronauts on EVA (extra-vehicular activity) occurs; and passengers and crew in high-flying aircraft at high latitudes can be exposed to radiation risk.</p> <p><b>Satellite operations:</b> Satellites can be rendered useless, memory impacts can cause loss of control, serious noise in image data can occur, star-trackers may be unable to locate sources; and permanent damage to solar panels is possible.</p> <p><b>Other systems:</b> Complete blackout of HF communications is possible through the polar regions, and position errors make navigation operations extremely difficult.</p>	$10^5$	Fewer than 1 per cycle
S 4	Severe	<p><b>Biological:</b> Unavoidable radiation hazard to astronauts on EVA can occur; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.</p> <p><b>Satellite operations:</b> Memory device problems and noise on imaging systems can occur; star-tracker problems can cause orientation problems, and solar panel efficiency can be degraded.</p> <p><b>Other systems:</b> Blackout of HF radio communications through the polar regions and increased navigation errors over several days are likely.</p>	$10^4$	3 per cycle
S 3	Strong	<p><b>Biological:</b> Radiation hazard avoidance is recommended for astronauts on EVA, and passengers and crew in high-flying aircraft at high latitudes can be exposed to radiation risk.</p> <p><b>Satellite operations:</b> Single-event upsets, noise in imaging systems, and slight reduction of efficiency in solar panel are likely.</p> <p><b>Other systems:</b> Degraded HF radio propagation through the polar regions and navigation position errors are likely.</p>	$10^3$	10 per cycle

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SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE (Flux level of $\geq 10$ MeV particles)	AVERAGE FREQUENCY (1 Cycle = 11 Years)
S 2	Moderate	<p><b>Biological:</b> Passengers and crew in high-flying aircraft at high latitudes can be exposed to elevated radiation risk.</p> <p><b>Satellite operations:</b> Infrequent single-event upsets are possible.</p> <p><b>Other systems:</b> Small effects on HF propagation through the polar regions can occur, and navigation at polar cap locations can be possibly affected.</p>	$10^2$	25 per cycle
S 1	Minor	<p><b>Biological:</b> None.</p> <p><b>Satellite operations:</b> None.</p> <p><b>Other systems:</b> Minor impacts on HF radio in the polar regions.</p>	10	50 per cycle

**Table 17-3. Radio Blackouts**

SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
R 5	Extreme	<p><b>HF Radio:</b> Complete HF (high frequency) radio blackout on the entire sunlit side of the Earth lasting for a number of hours can occur. This results in no HF radio contact with mariners and en route aviators in this sector.</p> <p><b>Navigation:</b> Low-frequency navigation signals used by maritime and general aviation systems can experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours can occur on the sunlit side of Earth, which may spread into the night side.</p>	$X20$ ( $2 \times 10^{-3}$ )	Less than 1 per cycle
R 4	Severe	<p><b>HF Radio:</b> HF radio communication blackout on most of the sunlit side of Earth can occur for one to two hours, and HF radio contact is lost during this time.</p>	$X10$ ( $10^{-3}$ )	8 per cycle (8 days per cycle)

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SCALE	DESCRIPTION	EFFECT	PHYSICAL MEASURE	AVERAGE FREQUENCY (1 CYCLE = 11 YEARS)
		<b>Navigation:</b> Outages of low-frequency navigation signals can cause increased error in positioning for one to two hours, and minor disruptions of satellite navigation are possible on the sunlit side of Earth.		
R 3	Strong	<b>HF Radio:</b> Wide area blackout of HF radio communication, and loss of radio contact for about an hour on sunlit side of Earth can occur. <b>Navigation:</b> Low-frequency navigation signals can be degraded for about an hour.	X1 ( $10^{-4}$ )	175 per cycle (140 days per cycle)
R 2	Moderate	<b>HF Radio:</b> Limited blackout of HF radio communication on the sunlit side of the Earth, and loss of radio contact for tens of minutes can occur. <b>Navigation:</b> Degradation of low-frequency navigation signals for tens of minutes can occur.	M5 ( $5 \times 10^{-5}$ )	350 per cycle (300 days per cycle)
R 1	Minor	<b>HF Radio:</b> Weak or minor degradation of HF radio communication on the sunlit side of the Earth, and occasional loss of radio contact can occur. <b>Navigation:</b> Low-frequency navigation signals can be degraded for brief intervals.	M1 ( $10^{-5}$ )	2000 per cycle (950 days per cycle)

The societal and economic impacts of a geomagnetic disturbance scenario have been mapped in Figure 17-1. Texas is at a zero percent for an at-risk transformer capacity. This does not mean that Texans are safe from power-grid failure. In recent years, utilities have joined grids together to allow long-distance transmission of low-cost power to areas experiencing sudden demand. The Interconnectedness of the power-grid makes the system susceptible to wide-ranging "cascade failures."<sup>2</sup>

The U.S. electric grid has three main components including generation (creation of electricity), transmission (long haul transport of electricity), and distribution (shorter distances connecting the electricity to the consumer and end user). The electric grid is complex with in increasing number of connection points. The U.S. has 80,000 miles of extra-high voltage (EHV) transmission lines comprising the backbone of the transmission grid that enables the long-haul transport of electricity. EHV transformers are considered critical equipment on the transmission grid and 90 percent of

<sup>2</sup> [http://science.nasa.gov/science-news/science-at-nasa/2009/21jan\\_severespaceweather/](http://science.nasa.gov/science-news/science-at-nasa/2009/21jan_severespaceweather/)

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consumed power passes through a high voltage transformer at some point. If EHV transformers fail, especially in large numbers, the resulting damage could be extensive.

EHV transformers are huge, weighing hundreds of tons, making them difficult to transport, and in some cases rare and specialized rail cars must be used for transport. Many of the EHV transformers installed in the U.S. are approaching or exceeding the end of their design lifetimes (approx. 30-40 years), increasing their vulnerability to failure. Although the utility industry does maintain limited spares, the ability to quickly and rapidly replace several transformers at once could be a challenge.<sup>3</sup>

**Figure 17-1. At Risk Extra High Voltage (EHV) Transformer Capacity Map by State**

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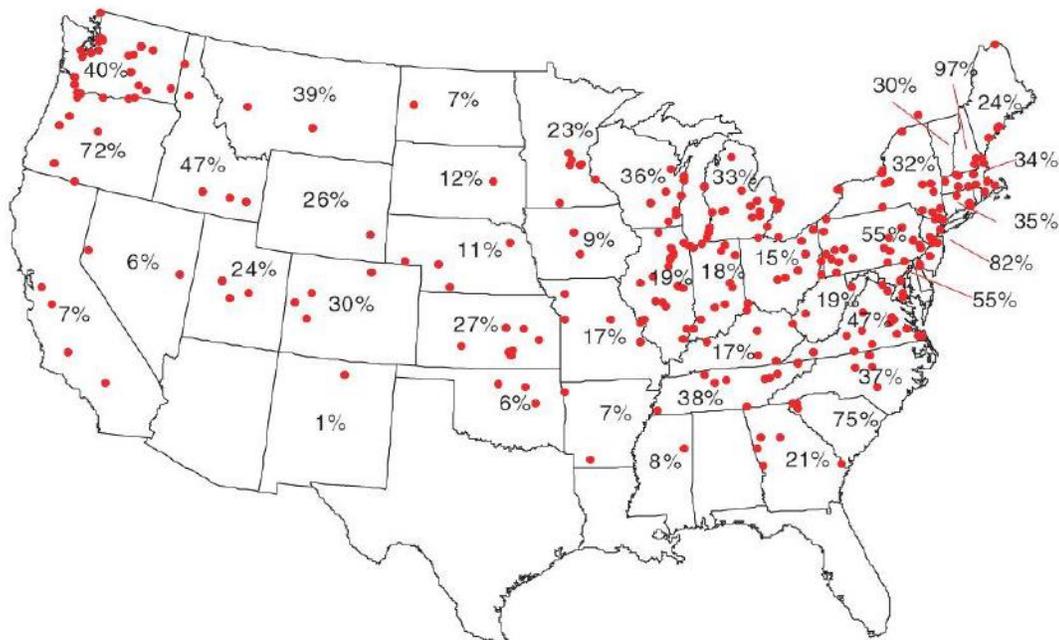


FIGURE 7.2 A map showing the at-risk EHV transformer capacity (estimated at ~365 large transformers) by state for a 4800 nT/min geomagnetic field disturbance at 50° geomagnetic latitude. Regions with high percentages of at-risk capacity could experience long-duration outages that could extend multiple years. SOURCE: J. Kappenman, Metatech Corp., "The Future: Solutions or Vulnerabilities?," presentation to the space weather workshop, May 23, 2008.

## Historical Occurrences

### October-November 2003

The Halloween Solar Storms were a series of solar flares and coronal mass ejections that occurred from mid-October to early November 2003, peaking around October 28–29. Satellite-based systems and communications were affected, aircraft were advised to avoid high altitudes near the Polar Regions, and a one-hour-long power outage occurred in Sweden as a result of the solar activity. Aurorae were observed at latitudes as far south as Texas and the Mediterranean countries of Europe.

<sup>3</sup> <http://www.dhs.gov/science-and-technology/power-hungry-prototyping-replacement-ehv-transformers>

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The Solar and Heliospheric Observatory (SOHO) satellite failed temporarily, and the Advanced Composition Explorer was damaged by the solar activity. Numerous other spacecraft were damaged or experienced downtime. Some spacecraft were intentionally put into safe mode in order to protect sensitive equipment. Astronauts aboard the International Space Station had to stay inside the more shielded parts of the Russian Orbital Segment to protect themselves against the increased radiation levels. Both the Ulysses spacecraft which was near Jupiter at the time, and Cassini, approaching Saturn, were able to detect the emissions. In April 2004, Voyager 2 was also able to detect them as they reached the spacecraft.

These events occurred during solar cycle 23, approximately three years after its peak in 2000, which was marked by another occurrence of solar activity known as the Bastille Day Flare.

### **March 9-13, 1989**

The March 1989 geomagnetic storm was a severe storm that caused the collapse of Hydro-Québec's electricity transmission system. It occurred during solar cycle 22.

The storm began on Earth with extremely intense auroras at the poles. The aurora could be seen as far south as Texas and Florida. As this occurred during the Cold War, an unknown number of people worried that a nuclear first-strike might be in progress. Others considered the intense auroras to be associated with the Space Shuttle mission STS-29, which had been launched on March 13, 1989 at 9:57:00 AM. The burst caused short-wave radio interference, including the disruption of radio signals from Radio Free Europe into Russia. It was initially believed that the signals had been jammed by the Soviet government.

Through the evening of March 13, a river of charged particles and electrons in the ionosphere flowed from west to east, inducing powerful electrical currents in the ground that surged into many natural nooks and crannies.

Some satellites in polar orbits lost control for several hours. Geostationary Operational Environmental Satellite (GOES) weather satellite communications were interrupted, causing weather images to be lost. National Aeronautics and Space Administration's (NASA) Tracking and Data Relay Satellite (TDRS)-1 communication satellite recorded over 250 anomalies caused by the increased particles flowing into its sensitive electronics. The Space Shuttle Discovery was having its own problems: a sensor on one of the tanks supplying hydrogen to a fuel cell was showing unusually high pressure readings on March 13, 1989. The problem went away after the solar storm subsided.

### **May 13 -15, 1921**

The May 1921 geomagnetic storm was a significant event caused by the impact of an extraordinarily powerful coronal mass ejection on Earth's magnetosphere. It took place May 13 through May 15, 1921 and was part of solar cycle 15. This event occurred before extensive interconnectivity of electrical systems and the general electrical dependency across infrastructures in the developed world, so the effect was restricted to certain sectors. Resulting ground currents were up to an order of magnitude greater than those of the March 1989 geomagnetic storm that blacked out large parts of northeastern North America. At the time, scientists estimated the size of the sunspot that began on May 10, 1921 and caused the storm, as being 94,000 by 21,000 miles (131,000 km by 33,800 km).

### **August 28-September 2, 1859**

The 1859 Solar Flare is the largest magnetic explosion recorded and is referred to as the Carrington Event, named for British Astronomer Richard Carrington, who witnessed growing sunspots and documented a bright white flash that lasted about five minutes. The impacts on Earth were colorful

## Section 17: Technological Disruption

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and bright auroras were seen as far south as Hawaii and Cuba. Telegraph operators experienced sparks from telegraph equipment that started fires. Scientists predict that such an event today would be devastating to the internet, communications, and power transformers, satellites, airplanes, or any GPS guided system. Solar activity is closely monitored as the sun storms have increased since 2011. Studies have shown that a solar storm of this magnitude occurring today would likely cause widespread problems for modern civilization. The solar storm of 2012 was of similar magnitude, but it passed Earth's orbit without striking the planet.

### Probability of Future Events

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Technological Disruptions are expected to continue in the near future. Solar storm activity is expected to increase and is being mapped by NASA's Solar Shield Project and NOAA's Space Weather Prediction Center to show strong currents and warn power companies to protect their systems. The entire City of Austin and AISD planning area could be affected should there be another major solar flare, dependent on location of penetration within the Earth's atmosphere.

### Vulnerability and Impact

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Different types of space weather can affect different technologies at Earth. Solar flares can produce strong x-rays that degrade or block high-frequency radio waves used for radio communication during events known as Radio Blackout Storms. Solar Energetic Particles (energetic protons) can penetrate satellite electronics and cause electrical failure. These energetic particles also block radio communications at high latitudes during Solar Radiation Storms. Space weather has been recognized as causing problems with new technology since the invention of the telegraph in the 19th century.

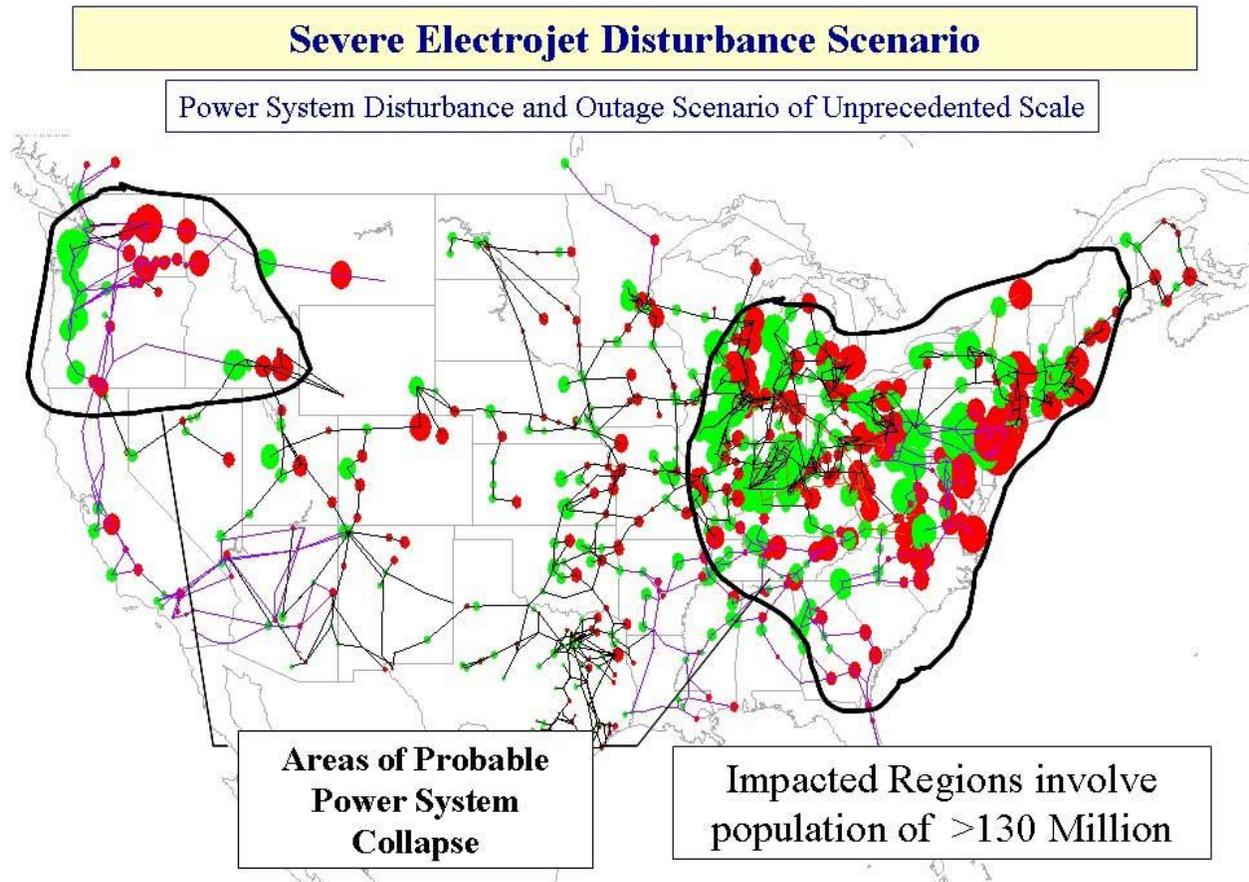
Besides emitting a continuous stream of plasma called the solar wind, the sun periodically releases billions of tons of matter called coronal mass ejections. These immense clouds of material, when directed toward Earth, can cause large magnetic storms in the magnetosphere and upper atmosphere. Such space weather can affect the performance and reliability of space-borne and ground-based technological systems. Coronal Mass Ejections (CME) can cause Geomagnetic Storms at Earth and induce extra currents in the ground that can degrade power grid operations.

Geomagnetic storms can modify the signal from radio navigation systems (GPS and GNSS) causing degraded accuracy. Geomagnetic storms also produce the aurora. Space weather will impact people who depend on all of these technologies.

A catastrophic failure of commercial and government infrastructure in space and on the ground can be mitigated through raising public awareness, improving vulnerable infrastructure and developing advanced forecasting capabilities. Without preventive actions or plans, the trend of increased dependency on space-weather sensitive technology, could make society more vulnerable to a technological disruption event in the future.

Figure 17-2 identifies a hypothetical scenario presented by a study on potential extreme space weather events that could result in a partial, wide-spread collapse of the U.S. electric power grid with enormous consequences for the affected population. As seen in Figure 17-2, the City of Austin and AISD planning area would be affected. Improvements in space weather forecasting, public awareness and infrastructure preparedness can mitigate the potential effects of technological disruption.

Figure 17-2. Power System Disturbance Scenario<sup>4</sup>



<sup>4</sup> Source: NASA

# Section 18: Infectious Diseases

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## Hazard Description

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An infectious disease is a clinically evident disease resulting from the presence of pathogenic microbial agents. According to FEMA, infectious diseases are a major threat around the world, killing millions globally each year. Transmission of an infectious disease may occur through one or more means including physical contact with infected individuals. These infecting agents may also be transmitted through liquids, food, bodily fluids, contaminated objects, airborne inhalation, or through vector-borne dissemination.

There are three classifications of disease impacts: endemic, epidemic, and pandemic. An endemic, is present at all times at a low frequency, such as chicken pox in the United States. An epidemic, is a sudden severe outbreak of disease, such as the bubonic plague during Medieval Times. A pandemic, is an epidemic that becomes very widespread and affects a whole region, a continent, or the world, for example the 1957 flu pandemic caused at least 70,000 deaths in the United States and one to two million deaths worldwide. In recent years, fears of pandemic have risen because the globalized economy and growing population fosters large scale international travel and trade. Growing populations increase the vulnerability because more densely populated areas increase the risk of exposure to an infectious disease, allowing the disease to rapidly advance the spread of the infection.

The top 11 infectious diseases according to the Global Burden of Disease Study of 2013 (GBD 2013),<sup>1</sup> based upon number of deaths, are presented in Table 18-1.

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<sup>1</sup> [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(14\)61682-2/fulltext](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(14)61682-2/fulltext)

**Table 18-1. Worldwide Mortality Due to Infectious Disease**

RANK	CAUSE OF DEATH	APPROXIMATE WORLDWIDE DEATHS IN 2013
1	Lower Respiratory Infections	4.2 million
2	Tuberculosis (TB)	1.94 million
3	Diarrheal diseases	1.9 million
4	HIV/AIDS	1.85 million
5	Malaria	1.2 million
6	Meningitis	430,000
7	Syphilis	190,000
8	Measles	130,000
9	Hepatitis B	110,000
10	Pertussis	80,000
11	Tetanus	80,000

There are many different types of infectious diseases. Due to the rise in certain diseases, the City of Austin and Austin Independent School District (AISD) are closely monitoring the following diseases that have affected the planning area.

### Human Immunodeficiency Virus

Human immunodeficiency virus (HIV) is spread through bodily fluids such as blood, semen, vaginal fluids, and breast milk. In the United States, HIV is most commonly transmitted from one person to another through unprotected anal or vaginal sex and through sharing needles or other drug paraphernalia. Transmission also can occur through transfusion of blood or its components from infected persons. In addition, a mother can pass HIV to her baby during pregnancy, during labor, or through breastfeeding. HIV infection is diagnosed by testing blood or saliva for antibodies to the virus or by directly testing for the presence of the virus. HIV damages the immune system leading to immunodeficiency; that is, the immune system is deficient in its ability to fight off infectious agents and cancer. Acquired immunodeficiency syndrome (AIDS) is the clinical stage of infection with HIV. The time from HIV infection to the development of AIDS is extremely variable ranging from less than one year to over 15 years.

The term most often used for people who are HIV positive is “person living with HIV/AIDS.”

The Centers for Disease Control and Prevention estimates that over one million persons, aged 13 years and older, are living with HIV infection. In the United States, gay, bisexual, and other men who have sex with men are considered most at risk of HIV infection.

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### Prevalent Foodborne Diseases

Foodborne disease is a term used to describe illnesses resulting from the consumption of contaminated foods. These diseases may be caused by bacteria, viruses, or toxins produced by these organisms. Contamination may occur during food production and preparation via inadequate sanitization, improper food handling, or holding food items at inadequate temperatures. The Centers for Disease Control and Prevention (CDC) estimate that one in six Americans, approximately 48 million people, have a foodborne illness each year.<sup>2</sup> Additionally, foodborne diseases kill thousands in the United States each year and cause billions of dollars in healthcare-related and industry costs annually.<sup>3</sup>

Foodborne disease rates in Travis County are significantly higher than those reported for Texas. Foodborne diseases are commonly underreported, and only a small proportion of illnesses are confirmed by laboratory testing; as a result, the higher Travis County rates could reflect an increased disease burden or a higher proportion of diseases identified and reported as compared to Texas overall.

The most common foodborne diseases reported in Travis County and Texas were Salmonellosis, Campylobacteriosis, Shigellosis, and Cyclosporiasis. Other forms of foodborne diseases are E Coli, Hepatitis A, and Listeriosis, which are listed in Table 18-2.

Commonly associated with contaminated food, water, or contact with infected animals, salmonellosis has been associated with many food items and animal exposures over the past few years. Nationally, salmonellosis is identified more frequently in children which is also the case in Travis County.<sup>4</sup> Travis County has seen a steady increase in salmonellosis cases from 2006 to 2012, which follows the national trend.

Campylobacteriosis is associated with eating raw or undercooked poultry, raw milk dairy products, contaminated produce and drinking water. Travis County has seen a stable trend in campylobacteriosis cases from 2006 to 2012.

Shigellosis is an illness caused by Shigella bacteria. It is transmitted by hand-to-mouth contact with stool (feces) from a sick person or animal, eating contaminated foods, or drinking contaminated water. Children and people who work in day care facilities are prone to contracting this disease. Other ways of contracting the disease may be through sexual practices or caring for someone who has Shigellosis; or traveling to other countries where the food/water supply is contaminated and unsafe.<sup>5</sup>

Cyclosporiasis is an intestinal illness caused by consuming food or water contaminated with the Cyclospora parasite. The major symptom is watery diarrhea lasting a few days to a few months. Additional symptoms may include loss of appetite, fatigue, weight loss, abdominal cramps, bloating, increased gas, nausea, vomiting and a low fever. To kill the parasite, fruits and vegetables must be fully cooked.<sup>6</sup> Last year, Texas had 200 cases, some of which were associated with cilantro from the Puebla region in Mexico. In 2015, there have been 77 reported cases of Cyclospora for Travis County.

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<sup>2</sup> <http://www.cdc.gov/foodborneburden/>

<sup>3</sup> [http://www.cdc.gov/WinnableBattles/FoodSafety/index.html?s\\_cid=fb165](http://www.cdc.gov/WinnableBattles/FoodSafety/index.html?s_cid=fb165)

<sup>4</sup> Ibid

<sup>5</sup> <http://www.dshs.state.tx.us/idcu/disease/shigellosis/>

<sup>6</sup> <http://www.dshs.state.tx.us/news/updates.shtm>

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### Prevalent Vectorborne Diseases

#### West Nile Virus

West Nile virus infection is the most common vectorborne disease in the United States. In nature, West Nile virus is spread between mosquitos and birds. Infected mosquitos will infect birds while getting a blood meal. Mosquitos can become infected by feeding on infected birds. West Nile virus is primarily transmitted to humans by the bite of an infected mosquito.

Transmission also may occur through blood transfusions, organ transplants, and from mother to baby during pregnancy, delivery, or breastfeeding. Most persons with a West Nile virus infection experience a fever with headache, body aches, and joint pains. Severe symptoms in some persons include encephalitis or meningitis.

#### Influenza A (H1N1)

In March of 2009, a novel strain of Influenza A (H1N1 or “Swine Flu”) virus was detected in Mexico and the United States. The virus has since spread worldwide. As of September 27, 2009, more than 340,000 cases of H1N1 have been confirmed worldwide and approximately 4,100 deaths have been reported.<sup>7</sup>

The most commonly reported symptoms include cough, fever, sore throat, and gastrointestinal symptoms, such as vomiting and diarrhea. Most individuals infected with H1N1 did not require hospitalization and had symptoms that lasted four days.<sup>8</sup>

#### H5N1 Avian Flu (Bird Flu)

H5N1 is a highly pathogenic avian (bird) flu virus that has caused serious outbreaks in domestic poultry in parts of Asia and the Middle East. Highly pathogenic refers to the virus’s ability to produce disease. Although H5N1 does not usually infect humans, nearly 650 cases of human cases of H5N1 have been reported from 15 countries since 2003.<sup>9</sup>

Most human cases of “highly pathogenic“ H5N1 virus infection have occurred in people who had recent contact with sick or dead poultry that were infected with H5N1 viruses. About 60% of people infected with the virus died from their illness.

Unlike other types of flu, H5N1 usually does not spread between people.

There have been no reported infections with these viruses in birds, poultry, or people in the United States.

It is rare for humans to be infected with this virus. You cannot get infected with these viruses from properly handled and cooked poultry or eggs. However, flu viruses are constantly changing and animal flu viruses can change such that they may gain the ability to infect people easily and spread among people, causing a pandemic.

#### Ebola Virus Disease (EVD)

Ebola is a viral hemorrhagic fever disease. Symptoms of Ebola may include fever, severe headache, muscle pain, vomiting, diarrhea, stomach pain, or unexplained bleeding or bruising. Symptoms may

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<sup>7</sup> World Health Organization

<sup>8</sup> Carrat, F. et al. Timelines of Infection and Disease in Human Influenza: A Review of Volunteer Challenge Studies. *American Journal of Epidemiology*, 2008, 167: 775–785.

<sup>9</sup> [http://www.flu.gov/about\\_the\\_flu/h5n1/index.html](http://www.flu.gov/about_the_flu/h5n1/index.html)

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appear anywhere from 2 to 21 days after exposure to the virus, although 8 to 10 days is most common for symptoms to occur.

The current Ebola outbreak is centered on three countries in West Africa, although there is potential for further spread to neighboring African countries. Ebola does not pose a significant risk to the United States public. There are no known cases of Ebola in the City of Austin or AISD.<sup>10</sup>

### Location

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Pandemics are random and only a few happen every century. The impacts from an infectious disease event can affect all areas of the world, therefore all areas are vulnerable. Since air travel and worldwide shipping have increased, it has become increasingly difficult to contain localized outbreaks as infected or exposed people travel across the globe in a matter of hours. Third world countries have fewer resources to fight disease and may be more vulnerable than more industrialized nations. In the United States, the U.S. public health system works at the federal, state and local level to monitor diseases, plan and prepare for outbreaks, and prevent epidemics where possible.

There is no distinct geographic boundary to infectious disease, therefore, it can occur throughout the City of Austin and AISD planning area.

### Extent

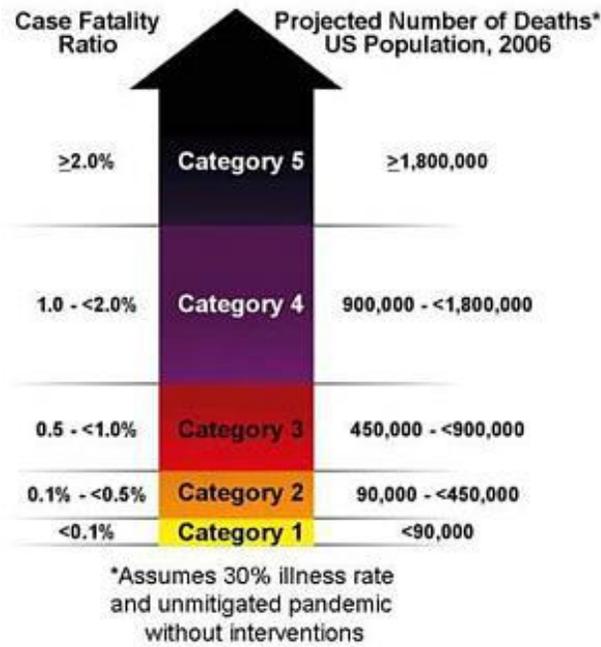
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The severity of a pandemic virus can be evaluated from the perspective of the individual who has been infected; or from the population level, how many complications and deaths might be expected as a whole. The most common measure of severity for a pandemic virus event is the case-fatality rate (CFR) as depicted in Figure 18-1.

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<sup>10</sup> <https://austintexas.gov/ebola>

**Figure 18-1. Case-Fatality Rate for Severity**



The magnitude of a pandemic event is identified in terms of warning levels based on population. Figure 18-2 illustrates the various warning levels for pandemic.

**Figure 18-2. Risk levels for Pandemic (World Health Organization)**



## Historical Occurrences

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The Austin/Travis County Health and Human Services Department has produced a 2015 Critical Health Indicators Report to illustrate health conditions and disparities in Travis County. Information in the 2015 report was primarily obtained from the United States Census Bureau, Texas Department of State Health Services, the Texas Behavioral Risk Factor Surveillance Survey, and from morbidity and mortality reports collected by the Disease Prevention and Health Promotion Division. The Critical Health Indicators Report was prepared by epidemiologists and staff in the Disease Prevention and Health Promotion Division using the most recent county, state, and national data available.<sup>11</sup>

The number of infectious disease cases and rates are included in Table 18-2. Rates for each year were configured using the number of cases per 100,000 total population. Rates based on fewer than 20 cases are likely to be unstable and imprecise. On average, 9,676 cases of infectious disease are reported annually for Travis County.

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<sup>11</sup> [http://www.austintexas.gov/sites/default/files/files/Health/Info\\_to\\_Post/Critical\\_Health\\_Indicators\\_2015.pdf](http://www.austintexas.gov/sites/default/files/files/Health/Info_to_Post/Critical_Health_Indicators_2015.pdf)

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**Table 18-2. Historical Infectious Disease for Austin and Travis County, 2008 – 2012<sup>12</sup>**

INFECTIOUS DISEASE	2008		2009		2010		2011		2012	
	Cases	Rate								
AIDS	148	15.0	153	15.1	129	12.6	127	12.2	112	10.6
Amebiasis	102	10.3	112	11.1	41	4.0	17	1.6	22	2.1
Anthrax	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Botulism	0	0.0	0	0.0	1	0.1	0	0.0	1	0.1
Brucellosis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Campylobacteriosis	114	11.5	131	12.9	182	17.8	140	13.4	182	17.2
Chicken Pox (Varicella)	255	25.8	140	13.8	127	12.4	98	9.4	143	13.5
Chlamydia	5,417	548.1	5,916	584.1	5,804	566.6	6,133	588.6	6,623	62.4
Cholera	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Creutzfeldt-Jakob Disease	0	0.0	1	0.1	1	0.1	0	0.0	0	0.0
Cryptosporidiosis	168	17.0	10	1.0	8	0.8	11	1.1	12	1.1
Cyclosporiasis	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0
Cysticercosis	1	0.1	0	0.0	1	0.1	0	0.0	2	0.2
Dengue	4	0.4	2	0.2	1	0.1	3	0.3	2	0.2
Diphtheria	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ehrlichiosis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Encephalitis	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2
Encephalitis, Nonarboviral	4	0.4	0	0.0	0	0.0	2	0.2	4	0.4
Escherichia coli , Shiga toxin-producing (STEC)	3	0.3	4	0.4	8	0.8	8	0.8	8	0.8
Gonorrhea	1,733	175.3	1,439	142.1	1,437	140.3	1,470	141.1	1,637	154.4
Haemophilus influenzae type b, invasive	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1
Hantavirus	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

<sup>12</sup> Source: Austin/Travis County Health & Human Services

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INFECTIOUS DISEASE	2008		2009		2010		2011		2012	
	Cases	Rate								
Hemolytic Uremic Syndrome (HUS)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Hepatitis A, Acute	9	0.9	9	0.9	12	1.2	6	0.6	5	0.5
Hepatitis B, Acute	27	2.7	31	3.1	18	1.8	10	1.0	11	1.0
Hepatitis B, Perinatal	1	0.1	0	0.0	0	0.0	1	0.1	1	0.1
Hepatitis C, Acute	0	0.0	0	0.0	1	0.1	2	0.2	1	0.1
Hepatitis Other, Acute	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
HIV	207	20.9	191	18.9	195	19.0	237	22.7	252	23.8
Influenza-associated pediatric mortality	0	0.0	2	0.2	1	0.1	0	0.0	1	0.1
Legionellosis	5	0.5	3	0.3	5	0.5	4	0.4	7	0.7
Leishmaniasis	0	0.0	0	0.0	0	0.0	0	0.0	2	0.2
Listeriosis	6	0.6	2	0.2	7	0.7	0	0.0	0	0.0
Lyme Disease	8	0.8	8	0.8	4	0.4	9	0.9	3	0.3
Malaria	5	0.5	5	0.5	10	1.0	3	0.3	5	0.5
Measles	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Meningitis, Aseptic	96	9.7	102	10.1	124	12.1	162	15.5	130	12.3
Meningitis, Bacterial and Other	12	1.2	2	0.2	7	0.7	2	0.2	7	0.7
Meningococcal Infection	7	0.7	4	0.4	1	0.1	1	0.1	2	0.2
Mumps	1	0.1	1	0.1	5	0.5	1	0.1	0	0.0
Pertussis	91	9.2	701	69.2	908	88.6	224	21.5	276	26.0
Plague	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Poliomyelitis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Primary Amoebic Meningoencephalitis (PAM)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Q Fever, Acute	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rabies, human	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0

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INFECTIOUS DISEASE	2008		2009		2010		2011		2012	
	Cases	Rate								
Rubella	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Salmonellosis	244	24.7	199	19.6	259	25.3	274	26.3	250	23.6
Shigella	148	15.0	75	7.4	176	17.2	316	30.3	146	13.8
Smallpox	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Spotted Fever Rickettsiosis	5	0.5	5	0.5	2	0.2	4	0.4	7	0.7
Streptococcus, Group A	28	2.8	24	2.4	18	1.8	24	2.3	26	2.5
Streptococcus, Group B	44	4.5	49	4.8	54	5.3	50	4.8	48	4.5
Streptococcus pneumonia	109	11.0	129	12.7	128	12.5	79	7.6	89	8.4
Syphilis <sup>12</sup>	294	29.7	307	30.3	284	27.7	365	35.0	411	38.8
Taeniasis	0	0.0	2	0.2	0	0.0	0	0.0	0	0.0
Tetanus	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0
Trichinosis	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Tuberculosis <sup>13</sup>	44	4.5	61	6.0	67	6.5	52	5.0	37	3.5
Tularemia	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Typhoid Fever	4	0.4	5	0.5	4	0.4	2	0.2	2	0.2
Typhus, Murine	33	3.3	34	3.4	15	1.5	54	5.2	42	4.0
Vancomycin- intermediate resistant Staphylococcus aureus (VISA)	1	0.1	4	0.4	1	0.1	1	0.1	1	0.1
Vancomycin-resistant Staphylococcus aureus (VRSA)	1	0.1	0	0.0	0	0.0	0	0.0	1	0.1
Vibrio Infections	2	0.2	5	0.5	6	0.6	4	0.4	2	0.2
West Nile Virus	2	0.2	2	0.2	2	0.2	0	0.0	153	14.4
Yellow Fever	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Yersiniosis	0	0.0	0	0.0	2	0.2	1	0.1	2	0.2

## Section 18: Infectious Diseases

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### HIV and AIDS

Table 18-3 reports the number of new HIV and AIDS cases in Travis County during 2003 through 2012. The number of cases of AIDS are those who were diagnosed in that year regardless of whether they were previously diagnosed as HIV only or if they were newly diagnosed and had already met the AIDS case definition. The annual number of new HIV diagnoses ranged from 191 to 252.

**Table 18-3. Number of New HIV and AIDS Diagnoses, Travis County, Texas, 2003 – 2012<sup>13</sup>**

DIAGNOSIS YEAR	HIV	AIDS
2003	207	140
2004	191	136
2005	221	169
2006	223	150
2007	224	161
2008	207	148
2009	191	153
2010	195	129
2011	237	127
2012	252	112
<b>Total</b>	<b>2,148</b>	<b>1,425</b>

### Influenza

During the 2013-2014 influenza season (September 29, 2013 through September 27, 2014) in Texas, the dominant strain during the first half was influenza A. Influenza B viruses and 2009 H1N1 were the dominant strain for the second half of the season. The season produced higher influenza-like illnesses (ILI) reported by providers than previous seasons with a total of 4,024 patient visits for ILI. Visits were highest in people aged 5 to 24 years old and lowest in adults from 50 to 64 years old.<sup>14</sup>

During the fall 2015 influenza season, there have already been 15 associated deaths with the City of Austin and Travis County residents. Figure 18-3 illustrates the percentage of visits to Travis County hospitals for influenza-like symptoms. Figure 18-4 displays the City of Austin influenza and pneumonia mortality rate from 2010 through 2015.

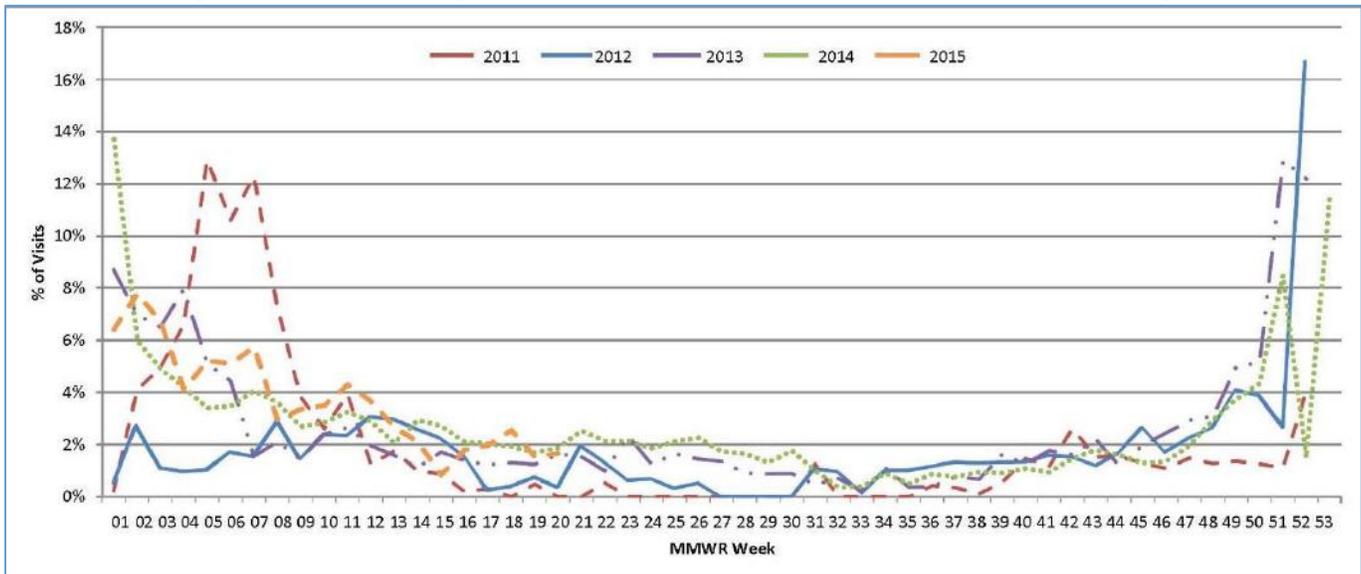
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<sup>13</sup> TB/HIV/STD Epidemiology and Surveillance Branch, Texas Department of State Health Services

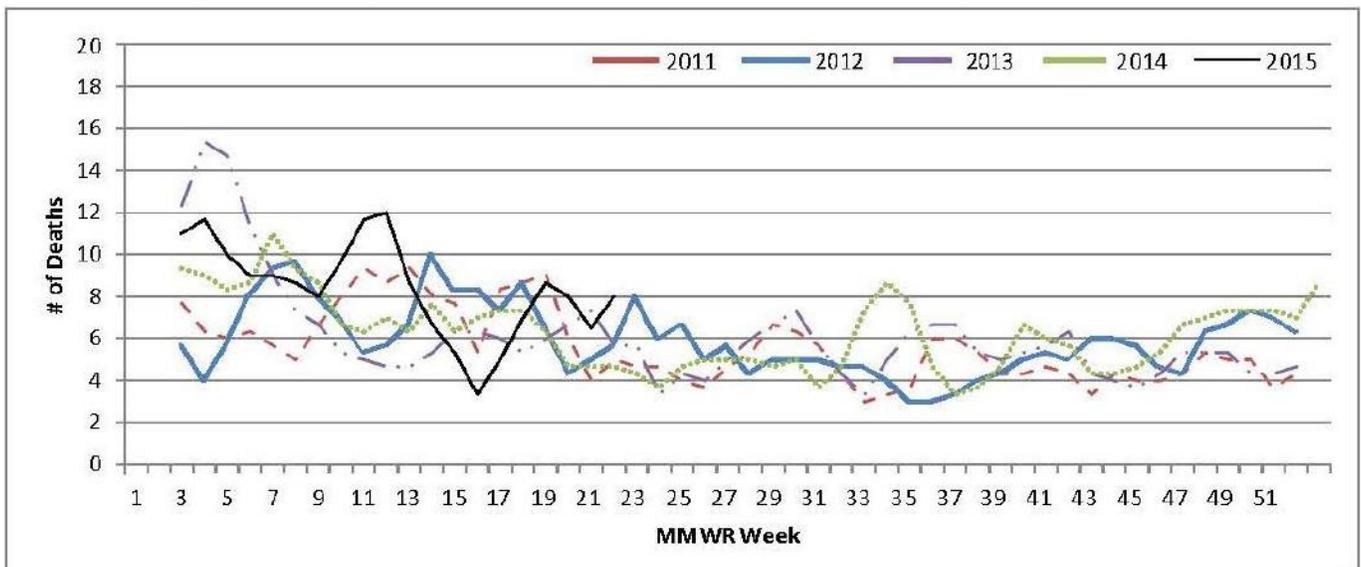
<sup>14</sup> <https://www.dshs.state.tx.us/idcu/disease/influenza/surveillance/2014/>

## Section 18: Infectious Diseases

**Figure 18-3. Percentage of Visits Due to Influenza-like-Illness, Travis County<sup>15</sup>**



**Figure 18-4. City of Austin Pneumonia and Influenza Mortality, 2010 – 2015<sup>16</sup>**



### West Nile Virus

During 2008 through 2011, only two West Nile virus cases were reported in Travis County. In 2012, the United States experienced an outbreak of West Nile virus with 5,674 cases reported.<sup>17</sup> A total of 286 persons in the United States died due to West Nile virus in 2012.<sup>18</sup> In 2012, over 1,800 cases were reported in Texas, with 153 of those cases occurring in Travis County causing 6 deaths. Ill

<sup>15</sup> <http://www.austintexas.gov/departments/influenza>

<sup>16</sup> Center for Disease Control and Prevention 122 Cities Mortality: <http://wonder.cdc.gov/mmwr/mmwmort.asp>

<sup>17</sup> Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report; 62:513-517

<sup>18</sup> Ibid

## Section 18: Infectious Diseases

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persons had onset of symptoms during July through October of 2012. The initial cases had onset of illness the second week of July, 2012.

There were 379 cases of West Nile virus in Texas in 2014 causing 6 deaths. Currently, there have been 6 reported cases in 2015, although none of those cases have occurred in Travis County.<sup>19</sup>

### Probability of Future Events

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Epidemics and pandemics have occurred in human and animal populations for thousands of years. As humans began to gather and congregate in urban areas, the potential for pandemics and epidemics increased. As trade routes became established and contact with other cities became more frequent, the potential for transmission of illnesses increased. In modern society, the ease of global travel has created a situation where viruses and bacteria can spread quickly from one continent to another.

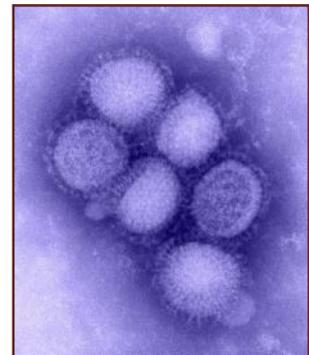
Historical evidence shows that the population of the City of Austin, including AISD, are vulnerable to disease outbreak, and the probability of future infectious disease or pandemic events is possible. Local public health officials maintain surveillance in hopes of identifying disease prominence and containing potential threats before they become epidemics. Of particular concern is the reduction and treatment of H1N1 flu virus.

The probability of an infectious disease epidemic or pandemic in the City of Austin and AISD planning area is occasional and an event has the probability of occurring once every five years.

### Vulnerability and Impact

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Estimated potential losses to the built environment are difficult to calculate because infectious disease causes little damage to the built environment and generally losses are experienced through public health response and medical costs, and lost wages of patients. Therefore, it is assumed that all buildings and facilities are exposed to disease but would experience negligible damage in the occurrence of an outbreak event. However, upkeep and maintenance of buildings and facilities would fall behind due to the high absenteeism of employees or the closing of facilities.



Critical infrastructure services, such as emergency services, utility services, water services and telecommunications can be limited by an infectious disease event. Certain strains of disease are highly infectious and can be communicable by coughing, touching, and even breathing. The City of Austin has seen a rise in West Nile Virus over the last few years. Other more prevalent diseases are Influenza and Chicken Pox (Varicella). Children within the school district are most likely to begin the spread of an infectious disease in the classroom setting, based on the number of children that share a classroom together. The AISD educates children and parents on the importance of hygiene for prevention of spreading infectious diseases.

People at the highest risk for developing complications from infectious diseases include children younger than five, adults 65 year of age and older, and pregnant women. People who have medical conditions, such as asthma; heart disease; chronic lung disease; blood, endocrine, kidney, liver or

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<sup>19</sup> <https://www.dshs.state.tx.us/news/updates.shtm>

## Section 18: Infectious Diseases

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metabolic disorders; or a weakened immune system, could experience a worsening of existing conditions.

The response costs to the public health sector for an outbreak, and the impact to health as a whole for the City of Austin and AISD planning area, could potentially be “Major.” Injuries or illnesses that result in permanent disability could occur and the City of Austin and AISD area facilities could be shut down for at least 2 weeks. Property damage could result from high absenteeism of persons responsible for property management.

### AISD Disease Prevention

It is a well-known fact that children are highly susceptible to infectious diseases, and some are spread throughout entire school districts. AISD works hard to educate children and their parents on disease prevention and takes steps to prevent the spread of the flu, including H1N1. Their goal is to decrease the exposure to the seasonal flu and H1N1, while limiting the disruption to learning. AISD works closely with the Center for Disease Control (CDC), Texas Department of State Health Services, and local Health Departments to monitor the situation. AISD enforces State mandated immunizations and also encourages flu vaccinations for all students.<sup>20</sup>

In 1996, AISD established a formal relationship with the Seton Healthcare Family to provide school health services on a contracted basis, in response to a need identified by the District. This program, named Children’s/AISD Student Health Services, is committed to optimizing the health and well-being of children and families, and is the first of its kind in the nation.<sup>21</sup>

Figure 18-5 illustrates the percentage of AISD campuses that have achieved 95% immunization compliance from 1996 through 2012 school years.

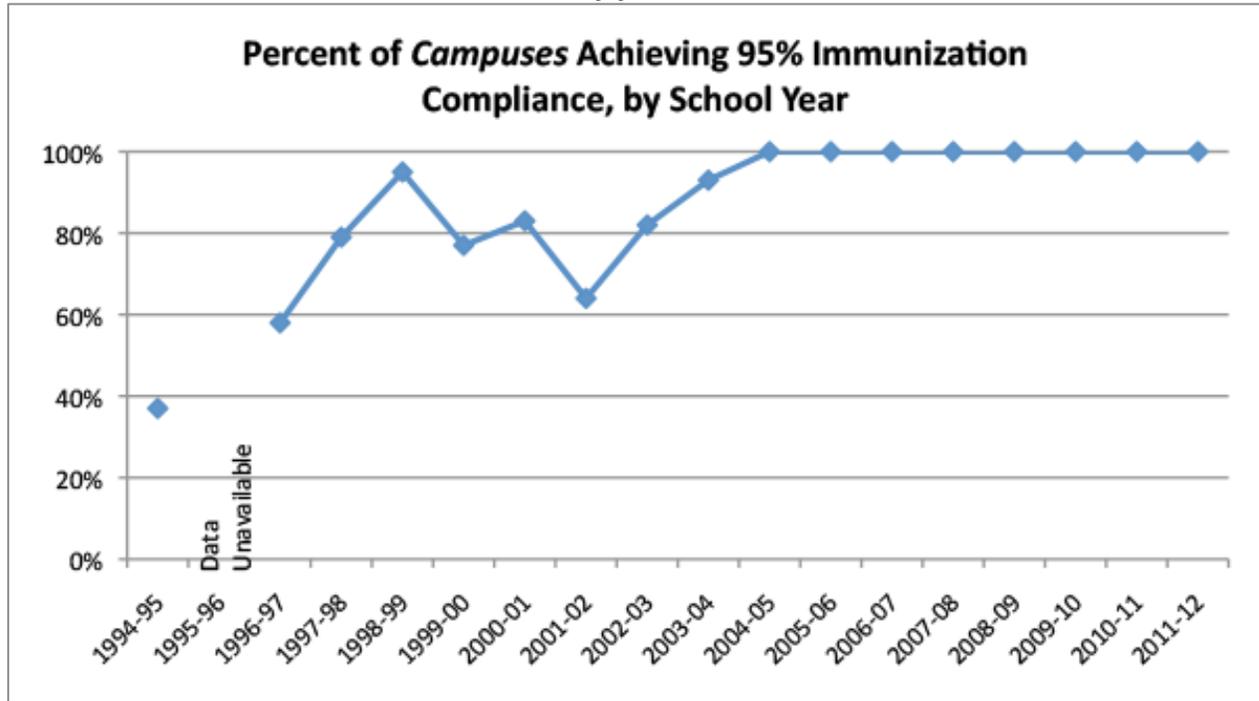
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<sup>20</sup> <http://www.austinisd.org/health/h1n1>

<sup>21</sup> <http://aisd.dellchildrens.net/>

Section 18: Infectious Diseases

Figure 18-5. Percentage of AISD campuses that have achieved 95% immunization compliance, by year



# Section 19: Terrorism

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Location.....	1
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## Hazard Description

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The Federal Bureau of Investigation (FBI) categorizes terrorism in the United States as domestic terrorism, or international terrorism. Domestic terrorism, involves groups or individuals whose terrorist activities are directed at elements of our government or population without foreign direction. International terrorism, involves groups or individuals whose terrorist activities are foreign-based, and directed by countries or groups outside the United States, or whose activities transcend their national boundaries.

A terrorist attack event can take several forms depending on the technological means available to the terrorist, nature of the issue motivating the attack, and points of weakness of the terrorist’s target. Bombing is the most frequently occurring terrorist event in the United States. A chemical or biological terrorist event is of particular concern to officials. Additionally, special training and equipment are necessary to safely manage a Weapons of Mass Destruction incident.

Biological agents, are infectious microbes or toxins used to produce illness or death in people, animals or plants. Biological agents can be dispersed as aerosols or airborne particles. Terrorists may use biological agents to contaminate food or water and may be extremely difficult to detect.

Chemical agents can kill and incapacitate people, destroy livestock, and ravage crops. Some chemical agents are odorless and tasteless and are therefore difficult to detect. Chemical agents can have an immediate effect, within a few seconds to a few minutes; or a delayed effect, within several hours to several days.

The U.S. Department of Defense estimates that 26 nations may possess chemical agents and weapons, and an additional 12 may be seeking to develop them. The Central Intelligence Agency reports that at least ten countries are believed to be in possession or conducting research on biological agents for weaponization.

Terrorist events involve the application of one or more modes of harmful force to the built environment. These modes include contamination, such as chemical, biological, radiological, and nuclear hazards; energy, such as explosives, arson, and electromagnetic waves; or denial of service, such as sabotage, infrastructure breakdown, and transportation service disruption.

## Location

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There is no distinct geographic boundary to the threat of terrorism. An event is possible throughout the City of Austin and Austin Independent School District (AISD).

## Section 19: Terrorism

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Terrorists most often search for highly visible targets that can be impacted while avoiding detection. However, the motivation behind a terrorist event can be varied and the target's surrounding area is considered at risk.

### Extent

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The National Terrorism Advisory System (NTAS), issued by the U.S. Department of Homeland Security (DHS). The NTAS consists of two types of advisories: Bulletins and Alerts. DHS has added Bulletins to the advisory system to be able to communicate current developments or general trends regarding threats of terrorism. When there is specific, credible information about a terrorist threat against the United States, DHS will share an NTAS Alert with the American public when circumstances warrant doing so. The Alert may include specific information, if available, about the nature of the threat, including the geographic region, mode of transportation, or critical infrastructure potentially affected by the threat, and steps that individuals and communities can take to protect themselves and help prevent, mitigate or respond to the threat. The Alert may take one of two forms: "Elevated," if there is credible threat information, but only general information about timing and target such that it is reasonable to recommend implementation of protective measures to thwart or mitigate against an attack; or "Imminent," if the threat is credible, specific, and impending in the very near term.<sup>1</sup>

**Table 19-1. NTAS Alert Levels<sup>2</sup>**

THREAT LEVEL <sup>3</sup>	TYPES OF ADVISORIES
Elevated	Warns of a credible terrorism threat against the United States
Imminent	Warns of a credible, specific and impending terrorism threat against the United States

The Red Cross also issues Advisory System Recommendations for individuals, families, neighborhoods, schools and businesses for each alert level. These may be found at: [www.redcross.org](http://www.redcross.org).

Heightened periods for terrorism risk are based on intelligence and other information. A potential terrorist event could devastate the community physically, economically and psychologically for many years to come. Warning time for terrorism is minimal to none. The City of Austin and AISD planning area could encounter any level of threat of terrorism as there is usually very little warning time and terrorist events are not typically foreseeable.

### Historical Occurrences

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In 2007, the Texas Department of Public Safety, which is responsible for Homeland Security in Texas, reported that individuals with ties to Hezbollah, Hamas, and al-Qaida were arrested crossing the border from Mexico. From March 2006 to September 2007, almost 350 individuals "from terrorism-related countries" were arrested at the border.

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<sup>1</sup> <http://www.dhs.gov/ntas-frequently-asked-questionsa>

<sup>2</sup> Department of Homeland Security

<sup>3</sup> Current threat levels can be found at: [http://www.dhs.gov/xinfo/share/programs/Copy\\_of\\_press\\_release\\_0046.shtm](http://www.dhs.gov/xinfo/share/programs/Copy_of_press_release_0046.shtm).

## Section 19: Terrorism

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### **April 25, 2007 – City of Austin**

A bomb was left in a women's clinic in the City of Austin, but failed to explode.

### **February 18, 2010 – City of Austin**

Andrew Joseph Stack III, flew his single engine plane into the Austin Texas IRS building killing himself and one IRS employee and injured 13 others. The event is considered a suicide attack. Stack left a suicide note online, comparing the IRS to Big Brother from the novel written in 1984.

### **May 31, 2013 – AISD**

An acid bomb was seized before detonation.

### **July 19, 2013 – City of Austin**

A Homeland Security warning was sent out July 19, 2013 warning of “unconfirmed” possible “random terrorist attacks” that while considered “random” specified several targets, noting supposed “plans to plant back-pack style bombs on 6th street on either 8 or 9 August.”

The threat advisory claimed there were plans to “attack a school and a theological seminary in the downtown Austin area and complete the attack with operations at the Austin Bergstrom International Airport.” The “unconfirmed” warning of “random” attacks further noted a backup date, August 29th, if the 8th and 9th weren't considered “a viable option.”

### **March 31, 2014 – AISD**

An act of Arson was committed on Cunningham Campus.

### **June 18, 2014 – City of Austin**

Rahatul Ashikim Khan of the Austin suburb of Round Rock and Michael Todd Wolfe who were residents of the City of Austin have been convicted of conspiring to provide material support to terrorists. Wolfe was sentenced in June, 2015 to almost 7 years in federal prison after pleading guilty to planning to travel to the Middle East to join the al-Qaida offshoot Islamic State of Iraq and Syria, or ISIS. Rahatul Ashikim Khan was sentenced to 10 years in federal prison for attempting to provide material to support terrorists.

### **November 28, 2014 – City of Austin**

Right-wing and anti-government extremist Larry Steven McQuilliams set a fire at the Mexican Consulate and shot towards several government buildings. Police arrived on scene and shot him dead. McQuilliams had a prior criminal history including drug possession and robbery.

## Probability of Future Events

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The type, frequency, and location of many natural hazards are identifiable and somewhat predictable because natural hazards are governed by the laws of physics and nature. However, malevolence cannot be forecast with any accuracy. Therefore, there is potential for intentional terrorist acts to occur anywhere and at any time. According to the historical incident data, a terrorism incident for the City of Austin and AISD planning area is likely, with an event occurring on average once every three years.

### Vulnerability and Impact

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There is no defined geographic boundary for a terrorist event. All of the population, buildings, critical facilities, infrastructure, lifelines, and hazardous materials facilities in the City of Austin and AISD planning area are considered exposed to the hazards of terrorism and could potentially be affected.

Because there have been terrorist attacks within Austin and the AISD, all assets and facilities are potentially at risk to damages.

Terrorist events can have a “Major” severity of impact. They can cause injuries and illnesses, and result in permanent disability, complete shutdown of City of Austin and AISD area facilities for at least two weeks, and cause more than 25 percent of affected properties to be destroyed or suffer major damage.

Terrorism poses a potentially significant risk to public health and safety. Persons in the area at the time of a terrorist attack are at risk for injury or death from a variety of threats.



The chance for death, injury, and financial loss increases as population density increases. Therefore, locations in the City of Austin and AISD planning area with high population density should be considered to have the most risk.

Response personnel face similar potential impacts as the general public. Response personnel can be at increased risk of physical injury because the nature of their responsibilities may bring them closer to the hazard and secondary incendiary devices are often directed at response personnel. Additionally, response personnel can be subjected to more long-term impacts resulting from prolonged exposure to chemicals or biological weapons.

Damage from a terrorist event can either directly or indirectly impact utility infrastructure. Damage to utility infrastructure can result in a temporary loss of function for businesses in the planning area that rely on utilities for operation. Additionally, businesses can suffer interruption from closed or blocked roadways; for example, firefighters and law enforcement personnel may need to close a roadway during response and investigative operations. This could negatively impact other businesses in the area that were not otherwise damaged.

Most property, facilities, and infrastructure within the City of Austin and AISD planning area are at risk from damage or destruction from a terrorist event, including residential and commercial structures and their supporting utilities, vehicles and transportation infrastructure, and community buildings, such as hospitals, police stations, and schools. Access to community buildings can be negatively impacted by the damage to roadways or closure of roadways in or near a terrorist event due to response or investigative operations.

Due to the varied ways a terrorist event can occur, there are many potential environmental impacts. The environmental impacts associated with terrorism include, but are not limited to:

- Air pollution,
- soil contamination,
- water pollution and hydrologic impacts, and

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- radiological contamination.

Examples of potential terrorist impacts on the environment:

- During severe drought, a terrorist group conducts an arson campaign with multiple fire-bomb attacks that result in large-scale fires throughout the area. Fire affected regions sustain losses to agriculture and forest areas.
- An intentional release of hazardous materials into soil, water, or air that leads to environmental contamination and potential changes of the ecosystem, such as habitat loss.
- Failure of control systems of major utility companies due to cyber-attack, leading to damages of critical infrastructure and consequent environmental impacts, such as uncontrolled release of chemicals into the environment, initiation of random fires, or radiological contamination.

The economic and financial impacts of a terrorist event on local government will depend on the scale of the event, what is damaged, costs of repair or replacement, lost business days in impacted areas, and how quickly repairs to critical components of the economy can be implemented. The level of preparedness and pre-event planning done by businesses and citizens will also contribute to the overall economic and financial conditions in the aftermath of a terrorist event.

# Section 20: Hazardous Materials

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## Hazard Description

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Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. A hazardous material (HAZMAT) incident involves a substance outside normal safe containment in sufficient concentration to pose a threat to life, property, or the environment.

Chemicals are found everywhere. They purify drinking water, increase crop production, and simplify household chores. But chemicals also can be hazardous to humans or the environment if used or released improperly. Hazards can occur during production, storage, transportation, use, or disposal. You and your community are at risk if a chemical is used unsafely or released in harmful amounts into the environment where you live, work, or play.

In a hazardous materials incident, solid, liquid, and/or gaseous contaminants may be released from fixed or mobile containers. Weather conditions will directly affect how the hazard develops.

The Toxics Release Inventory (TRI) is a publicly available database from the federal Environmental Protection Agency (EPA) which contains information on toxic chemical releases and other waste management activities that are reported annually by certain covered industry groups federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990. Each year, facilities that meet certain activity thresholds must report their releases and other waste management activities for listed toxic chemicals to the EPA and their state or tribal entity. A facility must report if it meets the following three criteria:

- The facility falls within one of the following industrial categories: manufacturing; metal mining; coal mining; electric generating facilities that combust coal and/or oil; chemical wholesale distributors; petroleum terminals and bulk storage facilities; Resource Conservation and Recovery Act (RCRA) Subtitle C Treatment, Storage and Disposal (TSD) facilities; and solvent recovery services.
- Have ten or more full-time employee equivalents.
- Manufactures or processes more than 25,000 pounds or otherwise uses more than 10,000 pounds of any listed chemical during the calendar year. Persistent, Bio-accumulative and Toxic (PBT) chemicals are subject to different thresholds of ten pounds, 100 pounds or 0.1 grams depending on the chemical.

Tier 2 data is a publicly available database from the Texas Department of State Health Services Tier 2 Chemical Reporting Program. Under EPCRA, all facilities which store significant quantities of hazardous chemicals must share this information with state and local emergency responders and

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planners. Facilities in Texas share this information by filing annual hazardous chemical inventories with the Texas Department of State Health Services (DSHS), Local Emergency Planning Committees (LEPCs), and local fire departments. The Texas Tier 2 Report contains facility identification information and detailed chemical data about hazardous chemicals stored at the facility.

A facility must report if it meets the following criteria:

- Any company using chemicals that could present a physical or health hazard must report them, according to Tier 2 requirements.
- If an industry has an Occupational Safety and Health Administration (OSHA) deemed hazardous chemical that exceeds the appropriate threshold at a certain point in time, then the chemical must be reported. These chemicals may be on the list of 356 Extremely Hazardous Substances (EHS) or could be one of the 650,000 reportable hazardous substances (not on the EHS list). This reporting format is for a "snapshot in time." EHS chemicals have to be reported if the quantity is either greater than 500 pounds, or if the Threshold Planning Quantity (TPQ) amount is less than 500 pounds.

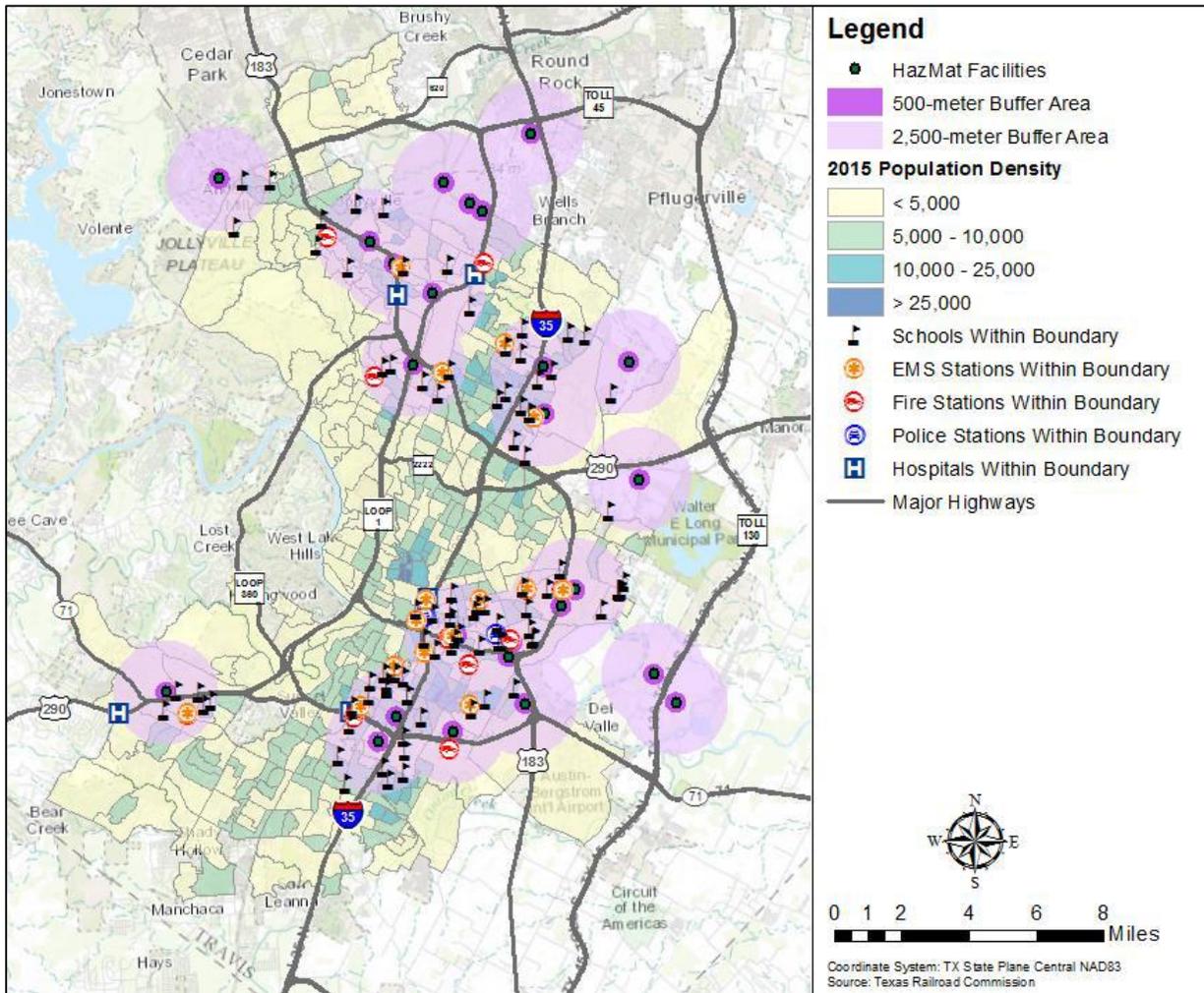
### Location

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Under the Community Right-to-Know program laws upheld at the state and federal level, all facilities which store significant quantities of hazardous chemicals must share this information with state and local emergency responders and planners. Facilities in Texas share this information by filing annual hazardous chemical inventories with the state, with Local Emergency Planning Committees (LEPCs), and with local fire departments.

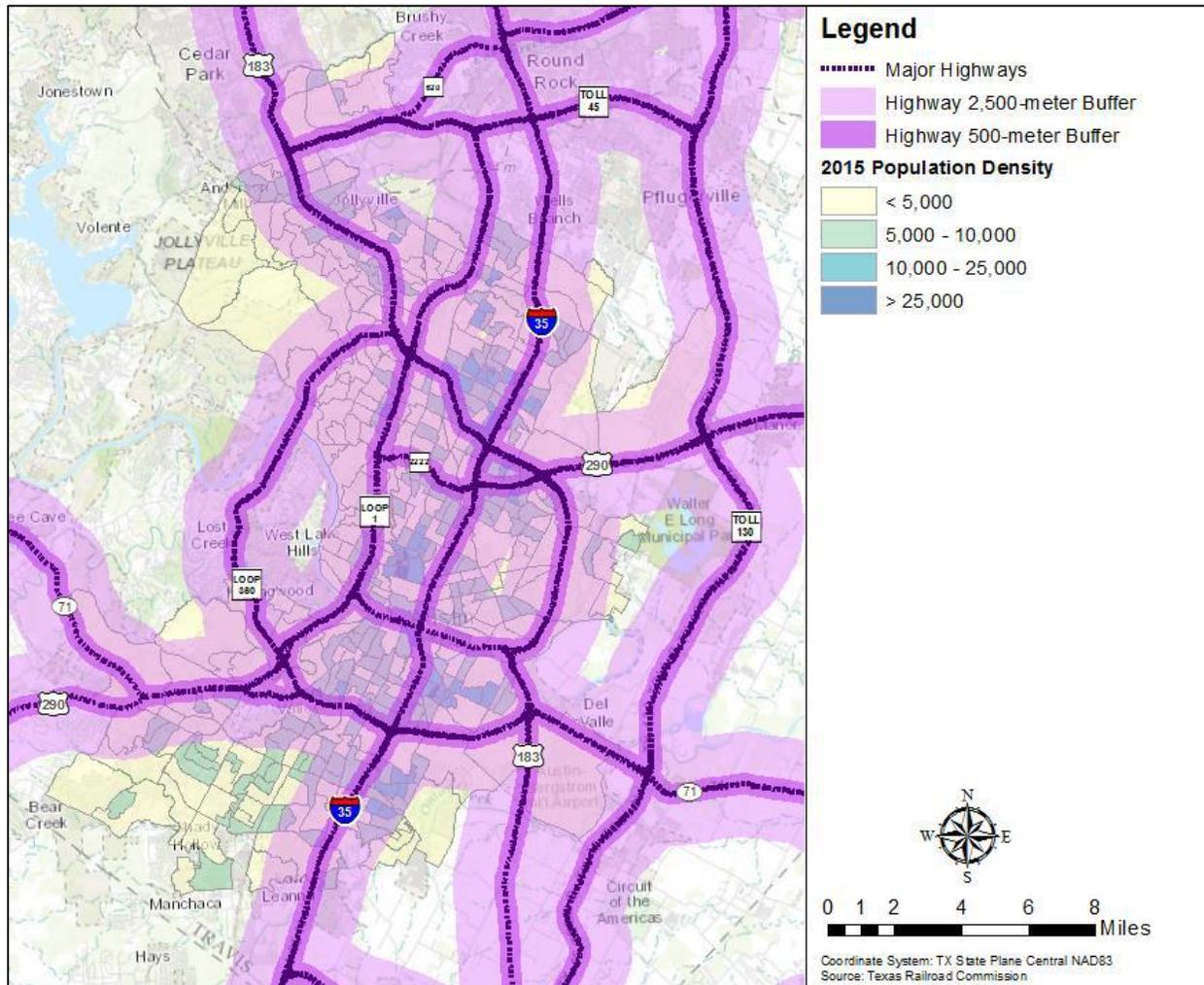
Figure 20-1 shows the locations of available georeferenced TRI and Tier 2 toxic sites in and around the City of Austin study area and Figure 20-2 shows the corridors are mobile hazardous materials. For fixed site analysis, only toxic sites that have georeferenced data available were analyzed and the circle buffers are drawn around each hazardous material site. Two size buffers, 500 and 2,500 meters are assumed in respect to the different levels of effect – immediate (primary) and secondary.

Figure 20-1. Fixed HazMat Analysis Locations and Buffers



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**Figure 20-2. Mobile HazMat Analysis Corridors and Buffers**



**Table 20-1. TRI HazMat Facilities within Austin Area**

JURISDICTION	FACILITY NAME	ADDRESS	TOTAL RELEASES	CHEMICALS
AUSTIN	3M CO-AUSTIN RESEARCH BOULEVARD SITE	11705 RESEARCH BLVD	100.27	LEAD COMPOUNDS
AUSTIN	APAC - TEXAS INC/WHEELER COMPANIES/973 PLANT	2860 N FM 973	0.2001	LEAD
AUSTIN	AUSTIN COUNTER TOPS INC	11108 BLUFF BEND DR	14364	STYRENE
AUSTIN	AUSTIN MANUFACTURING SERVICES	4616 W HOWARD LN BLDG 5 STE 550	0	LEAD COMPOUNDS
AUSTIN	AUSTIN WHITE LIME CO	14001 MCNEIL RD	23075.8	BARIUM COMPOUNDS
AUSTIN	AUSTIN WHITE LIME CO	14001 MCNEIL RD	404.39	LEAD COMPOUNDS

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JURISDICTION	FACILITY NAME	ADDRESS	TOTAL RELEASES	CHEMICALS
AUSTIN	AUSTIN WHITE LIME CO	14001 MCNEIL RD	3.846	MERCURY COMPOUNDS
AUSTIN	BAE SYSTEMS INFORMATION & ELECTRONIC SYSTEMS INTEGRATION INC	6500 TRACOR LN	71.7	LEAD
AUSTIN	BORDEN DAIRY CO OF TEXAS LLC	71 STRANDTMAN COVE	0	NITRATE COMPOUNDS
AUSTIN	BORDEN DAIRY CO OF TEXAS LLC	71 STRANDTMAN COVE	0	NITRIC ACID
AUSTIN	CELESTICA AEROSPACE TECHNOLOGIES CORP	4616 W HOWARD LN BLDG 1 SUITE 100	0.197181	LEAD
AUSTIN	ERGON ASPHALT & EMULSIONS INC - AUSTIN	8803 N MOPAC EXPRESSWAY	0	POLYCYCLIC AROMATIC COMPOUNDS
AUSTIN	ERGON ASPHALT & EMULSIONS INC - AUSTIN	8803 N MOPAC EXPRESSWAY	0	BENZO(G,H,I) PERYLENE
AUSTIN	FLEXTRONICS AMERICA LLC	12455 RESEARCH BLVD	61.44	LEAD
AUSTIN	FLEXTRONICS AMERICA LLC	12455 RESEARCH BLVD	14.49	COPPER
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	1839	N-HEXANE
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	20	NAPHTHALENE
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	0	POLYCYCLIC AROMATIC COMPOUNDS
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	1154	XYLENE (MIXED ISOMERS)
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	827	TOLUENE
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	1	LEAD COMPOUNDS
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	264	1,2,4-TRIMETHYLBENZENE
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	175	CYCLOHEXANE
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	0	BENZO(G,H,I) PERYLENE

## Section 20: Hazardous Materials

JURISDICTION	FACILITY NAME	ADDRESS	TOTAL RELEASES	CHEMICALS
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	148	CUMENE
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	159	BENZENE
AUSTIN	FLINT HILLS RESOURCES CORPUS CHRISTI LLC AUSTIN TERMINAL	9011 JOHNNY MORRIS RD	51	ETHYLBENZE NE
AUSTIN	FREESCALE SEMICONDUCTOR - ED BLUESTEIN FACILITY	3501 ED BLUESTEIN BLVD	750	NITRIC ACID
AUSTIN	FREESCALE SEMICONDUCTOR - ED BLUESTEIN FACILITY	3501 ED BLUESTEIN BLVD	7056	ETHYLENE GLYCOL
AUSTIN	FREESCALE SEMICONDUCTOR - ED BLUESTEIN FACILITY	3501 ED BLUESTEIN BLVD	237	HYDROGEN FLUORIDE
AUSTIN	FREESCALE SEMICONDUCTOR - ED BLUESTEIN FACILITY	3501 ED BLUESTEIN BLVD	0	OZONE
AUSTIN	FREESCALE SEMICONDUCTOR - ED BLUESTEIN FACILITY	3501 ED BLUESTEIN BLVD	18	SULFURIC ACID
AUSTIN	FREESCALE SEMICONDUCTOR - ED BLUESTEIN FACILITY	3501 ED BLUESTEIN BLVD	366	N-METHYL-2- PYRROLIDON E
AUSTIN	FREESCALE SEMICONDUCTOR - ED BLUESTEIN FACILITY	3501 ED BLUESTEIN BLVD	0	NITRATE COMPOUNDS
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	1	LEAD
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	1245	ETHYLENE GLYCOL
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	312	HYDROGEN FLUORIDE
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	339	NITRIC ACID
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	0	NITRATE COMPOUNDS

## Section 20: Hazardous Materials

JURISDICTION	FACILITY NAME	ADDRESS	TOTAL RELEASES	CHEMICALS
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	60	N-METHYL-2-PYRROLIDONE
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	808	HYDROCHLORIC ACID
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	0	OZONE
AUSTIN	FREESCALE SEMICONDUCTOR OAK HILL FACILITY	6501 WILLIAM CANNON DR W	0	SULFURIC ACID
AUSTIN	HANSON PIPE & PRECAST LLC AUSTIN	801 AIRPORT BLVD	0.44	LEAD
AUSTIN	HOSPIRA INC-AUSTIN SITE	3900 HOWARD LN	22.26	DI(2-ETHYLHEXYL) PHTHALATE
AUSTIN	HUBBELL BUILDING AUTOMATION	9601 DESSAU RD BLDG 1 SUITE 100	0.394735	LEAD
AUSTIN	NATIONAL INSTRUMENTS CORP	11500 N MOPAC EXPWY.	0	LEAD
AUSTIN	OLDCASTLE ARCHITECTURAL WEST INC	4433 TERRY-O LN	0.05	LEAD
AUSTIN	PALM HARBOR HOMES INC	830 BASTROP HWY	0	DIISOCYANATES
AUSTIN	PURE CASTINGS CO	2110 E 4TH ST	676.26	CHROMIUM
AUSTIN	PURE CASTINGS CO	2110 E 4TH ST	360.43	NICKEL
AUSTIN	SACHEM INC	821 WOODWARD ST	0	NITRIC ACID
AUSTIN	SACHEM INC	821 WOODWARD ST	0	NITRATE COMPOUNDS
AUSTIN	SACHEM INC	821 WOODWARD ST	0	CHLORINE
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	13573	N-METHYL-2-PYRROLIDONE
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	13747	ETHYLENE GLYCOL
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	18565	SULFURIC ACID
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	2065	OZONE
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	4179	HYDROGEN FLUORIDE

## Section 20: Hazardous Materials

JURISDICTION	FACILITY NAME	ADDRESS	TOTAL RELEASES	CHEMICALS
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	77795	SODIUM DIMETHYLDI THIOCARBAMATE
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	4	NITRATE COMPOUNDS
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	5898	NITRIC ACID
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	3365	COPPER COMPOUNDS
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	13841	HYDROCHLORIC ACID
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	748	CHLORINE
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	2031.042	FLUORINE
AUSTIN	SAMSUNG AUSTIN SEMICONDUCTOR	12100 SAMSUNG BLVD	14219	AMMONIA
AUSTIN	SPANSION LLC	5204 E BEN WHITE BLVD	0	NITRATE COMPOUNDS
AUSTIN	SPANSION LLC	5204 E BEN WHITE BLVD	876	HYDROGEN FLUORIDE
AUSTIN	SPANSION LLC	5204 E BEN WHITE BLVD	350	SULFURIC ACID
AUSTIN	SPANSION LLC	5204 E BEN WHITE BLVD	0	FLUORINE
AUSTIN	SPANSION LLC	5204 E BEN WHITE BLVD	157	OZONE
AUSTIN	SPANSION LLC	5204 E BEN WHITE BLVD	350	AMMONIA
AUSTIN	SPANSION LLC	5204 E BEN WHITE BLVD	88	NITRIC ACID
AUSTIN	TXI-GREEN READY MIX	13101 HAROLD GREEN RD	0.0005	MERCURY COMPOUNDS
AUSTIN	TXI-GREEN READY MIX	13101 HAROLD GREEN RD	0.155	LEAD COMPOUNDS
AUSTIN	TXI-VOLENTE READY MIX	12210 VOLENTE RD	0.076	LEAD COMPOUNDS
AUSTIN	WAYNE FUELING SYSTEMS	3814 JARRETT WAY	0.4	LEAD

### Extent

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The extent of a hazardous material release will depend on whether it is from a mobile or fixed site and the size of impact. The range of intensity will vary greatly depending on the circumstances. These factors and conditions include the material, toxicity, duration of the release, and environmental conditions such as the wind and precipitation.

Hazardous materials or toxic releases can have substantial impact on communities. Such events can cause multiple deaths, completely shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage. In a hazardous materials incident, solid, liquid and/or gaseous contaminants may be released from fixed or mobile containers. Weather conditions would directly affect how the hazard develops. The micro-meteorological effects on buildings and terrain can alter travel patterns and duration of agents. Shielding in the form of permanent shelter can protect people from harmful effects. Non-compliance with fire and building codes, as well as failure to maintain existing fire and containment features can substantially increase damage from a hazardous materials release. The duration of a hazardous materials incident can range from hours to days. Warning time is minimal to none.

The spatial extent of a hazardous material release is minimal or expected to affect less than 10% of people or property.

### Historical Occurrences

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Hazardous materials are substances which if released or misused can cause death, serious injury, long-lasting health effects, and damage to structure and other properties as well as to the environment. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines.

It's estimated as many as 40 percent of the transport trucks moving through Central Texas and Travis County are carrying some form of hazardous materials, according to a 2009 report by TxDOT and the Federal Highway Administration. But that's just a guess based on national trends that break down transported goods by mode: truck, rail, pipeline, water, and air.

There's data on truck traffic volume in a study done last year by researchers for TxDOT. While most of the traffic is local, they counted 4,290 trucks of all kinds that could be moved off I-35 -- about 14% of overall traffic. Every normal weekday last year, up to 226,000 vehicles traveled past I-35 and Braker Lane on their way through the Austin region, the study found.

Compared to larger centers in Texas like Houston and its fuel transportation-based economy, truck accidents involving hazardous materials are relatively rare along Austin's piece of IH-35 and surrounding commuter corridors. But they do happen. Federal Hazardous Materials Safety Administration (FHMSA) data show since 2008, 91 spills involving some kind of dangerous truck cargo in Central Texas, most during loading or unloading.

The most dramatic happened during transit and include:

**Oct 30th, 2010** – US183 and MoPac. 9,500 gallons of gasoline burned when a tanker rolled off an overpass. The intense heat threatened the structure's stability.

## Section 20: Hazardous Materials

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**March 28th, 2012** – Toll 130 and Maha Loop. 9,500 gallons of gasoline burned when a car slammed into a tanker truck, killing the car's driver.

**Sep 27th, 2012** – I-35 NB at Slaughter Lane. 2,900 gallons of a gasoline mix spilled when a tanker rolled into the grassy median. The driver said he veered to avoid an animal in the roadway. No one else was injured.

### Probability of Future Events

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The likelihood or future probability of occurrence of a hazardous materials release in the City of Austin planning area is low, with more than a 25 percent chance of an event occurring in a given year.

### Vulnerability and Impact

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Based on the prevalence and geographic proximity of hazardous materials transportation routes and fixed locations, the majority of the City of Austin's planning area is vulnerable. The risk to the population depends on a variety of factors, including: type and amount of chemical released, weather conditions, prevailing winds, time of day, and season.

The environment is often vulnerable in a hazardous materials incident and can be heavily damaged by a hazardous materials incident. The particular transportation route and fixed site involved are significant factors in determining the risk to public health and safety, and will determine the number of people in proximity to the hazard. Depending on the nature of the hazardous materials incident, the public could be required to either evacuate the area or shelter in place, which will interrupt normal routines.

It is possible that a hazardous materials incident could involve a number of fatalities. It is likely that inhaled hazardous gasses may result in respiratory problems, including burning sensations in the lungs, nose, and throat. Releases that involve solids or liquids can be absorbed through the skin, and may cause burns on contact. In some instances, the threat to health and safety may not be evident for an extended period of time.

Hazardous Material Releases were included in the 2010 Plan Update, and also in this Update as toxic releases can have a substantial impact. Such events can cause multiple deaths, completely shut down facilities for 30 days or more, and cause more than 50 percent of affected properties to be destroyed or suffer major damage.

## Section 20: Hazardous Materials

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**Table 20-2. Critical Facilities Vulnerable to Hazardous Material Releases, 500 Meter Buffer**

NAME	TYPE
East Sub-Station	Police Department
Station 10	EMS Station
Station 13	EMS Station
Demand 1	EMS Station
ALLAN ELEMENTARY	School
ZAVALA ELEMENTARY	School
UNIVERSITY OF TEXAS ELEMENTARY CHARTER SCHOOL	School

**Table 20-2. Critical Facilities Vulnerable to Hazardous Material Releases, 2,500 Meter Buffer**

NAME	TYPE
Main Headquarters	Police Department
North Austin Medical Center	Hospital
Seton Northwest Hospital	Hospital
Seton Southwest Hospital	Hospital
South Austin Medical Center	Hospital
University Medical Center at Brackenridge	EMS Station
Station 01	EMS Station
Station 03	EMS Station
Station 04	EMS Station
Station 06	EMS Station
Station 07	EMS Station
Station 11	EMS Station
Station 12	EMS Station
Station 18	EMS Station
Demand 3	EMS Station
Headquarters	EMS Station

## Section 20: Hazardous Materials

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NAME	TYPE
Education Development & Wellness Div	EMS Station
EMS Garage	EMS Station
HARMONY SCHOOL OF EXCELLENCE	School
TRAVIS COUNTY DAY SCHOOL	School
KIPP AUSTIN COLLEGIATE	School
THE EAST AUSTIN COLLEGE PREP ACADEMY	School
OAK MEADOWS ELEMENTARY	School
PIONEER CROSSING ELEMENTARY	School
EDEN PARK ACADEMY	School
AUSTIN CAN ACADEMY CHARTER SCHOOL	School
KIPP AUSTIN ACADEMY OF ARTS & LETTERS	School
GARCIA YOUNG MENS LEADERSHIP ACADEMY	School
HARMONY SCIENCE ACADEMY - AUSTIN	School
TRAVIS COUNTY JUVENILE DETENTION CENTER	School
PHOENIX ACADEMY	School
SMALL MIDDLE	School
MCBEE ELEMENTARY	School
RODRIGUEZ ELEMENTARY	School
TEXAS EMPOWERMENT ACADEMY	School
LEADERSHIP ACADEMY	School
PLEASANT HILL ELEMENTARY	School
BATY ELEMENTARY	School
TRAVIS COUNTY STATE JAIL	School
CANYON CREEK ELEMENTARY	School
TRAVIS HIGH	School

## Section 20: Hazardous Materials

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NAME	TYPE
ANDERSON HIGH	School
GARZA INDEPENDENCE HIGH	School
FULMORE MIDDLE	School
KEALING MIDDLE	School
BURNET MIDDLE	School
MARTIN MIDDLE	School
DOBIE MIDDLE	School
ALLISON ELEMENTARY	School
BLACKSHEAR ELEMENTARY	School
BROOKE ELEMENTARY	School
DAWSON ELEMENTARY	School
GOVALLE ELEMENTARY	School
METZ ELEMENTARY	School
OAK SPRINGS ELEMENTARY	School
ORTEGA ELEMENTARY	School
SANCHEZ ELEMENTARY	School
ST ELMO ELEMENTARY	School
SUMMITT ELEMENTARY	School
SIMS ELEMENTARY	School
TRAVIS HEIGHTS ELEMENTARY	School
PATTON ELEMENTARY	School
PATTON ELEMENTARY	School
OAK HILL ELEMENTARY	School
BARRINGTON ELEMENTARY	School
NORMAN ELEMENTARY	School
PILLOW ELEMENTARY	School
HILL ELEMENTARY	School

## Section 20: Hazardous Materials

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NAME	TYPE
GRAHAM ELEMENTARY	School
LINDER ELEMENTARY	School
HOUSTON ELEMENTARY	School
HART ELEMENTARY	School
GALINDO ELEMENTARY	School
DAVIS ELEMENTARY	School
COPPERFIELD ELEMENTARY	School
NOEL GRISHAM MIDDLE	School
CANYON VISTA MIDDLE	School
KATHY CARAWAY ELEMENTARY	School
PURPLE SAGE ELEMENTARY	School
POND SPRINGS ELEMENTARY	School
JOLLYVILLE ELEMENTARY	School
WALNUT CREEK ELEMENTARY	School
GEORGE M KOMETZKY SCHOOL	School
AUSTIN DISCOVERY SCHOOL	School
INTERNATIONAL HIGH	School
KIPP AUSTIN COLLEGE PREP	School
AMERICAN YOUTHWORKS SERVICE LEARNING ACADEMY	School
EASTSIDE MEMORIAL AT JOHNSTON CAMPUS	School
HARMONY SCHOOL OF SCIENCE - AUSTIN	School
KIPP AUSTIN COMUNIDAD	School
KIPP AUSTIN CONNECTIONS ELEMENTARY	School
KIPP AUSTIN BEACON PREP	School
THE EAST AUSTIN COLLEGE PREP AT MLK	School

## Section 20: Hazardous Materials

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NAME	TYPE
IDEA ALLAN COLLEGE PREP	School
PREMIER HIGH SCHOOL AT TRAVIS	School
IDEA ALLAN ACADEMY	School
DOBIE PK CENTER	School
GUERRERO THOMPSON ELEMENTARY	School
SAN JUAN DIEGO CATHOLIC HIGH SCHOOL	School
ST IGNATIUS MARTYR SCHOOL	School
CATHEDRAL SCHOOL OF ST MARY - AUSTIN	School
OUR SAVIOR LUTHERAN SCHOOL AUSTIN	School
BRENTWOOD CHRISTIAN SCHOOL	School
HOLY WORD LUTHERAN SCHOOL	School
AUSTIN MONTESSORI SCHOOL	School
COUNTRY HOME LEARNING CENTER NO 8	School
COUNTRY HOME LEARNING CENTER NO 7	School
PADRON ELEMENTARY	School
ALTERNATIVE LEARNING CENTER	School

# Section 21: Pipeline Failure

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## Hazard Description

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Energy pipeline breach or pipeline failure of an oil or natural gas pipeline is a serious hazard event. An estimated 2.4 million miles of pipelines in the United States carry hazardous materials. Natural gas pipelines transport natural gas and oil. Liquid petroleum pipelines transport crude oil and refined products from crude oils, such as gasoline, home heating oil, jet fuel, kerosene, liquefied propane, ethylene, butane and petrochemical products. Oil pipelines can also transport liquefied gases, such as carbon dioxide.



Pipeline failure is a rare occurrence and has the potential to cause extensive property damage and loss of life. Pipelines have caused fires and explosions that killed more than 200 people and injured more than 1,000 people nationwide with 50 of the injuries in Texas in the last decade.

## Location

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Figure 21-1 shows the location of energy pipelines (gas and oil) in and around the City of Austin. Figure 21-2 shows the population density around the pipelines within the Austin Area. If any of these energy pipelines, oil or gas, were to rupture, such an event could endanger property and lives in the immediate area (up to 500 meters for immediate [primary] impact and up to 2,500 meters for secondary impact).

# Section 21: Pipeline Failure

Figure 21-1. Location of Pipelines in City of Austin

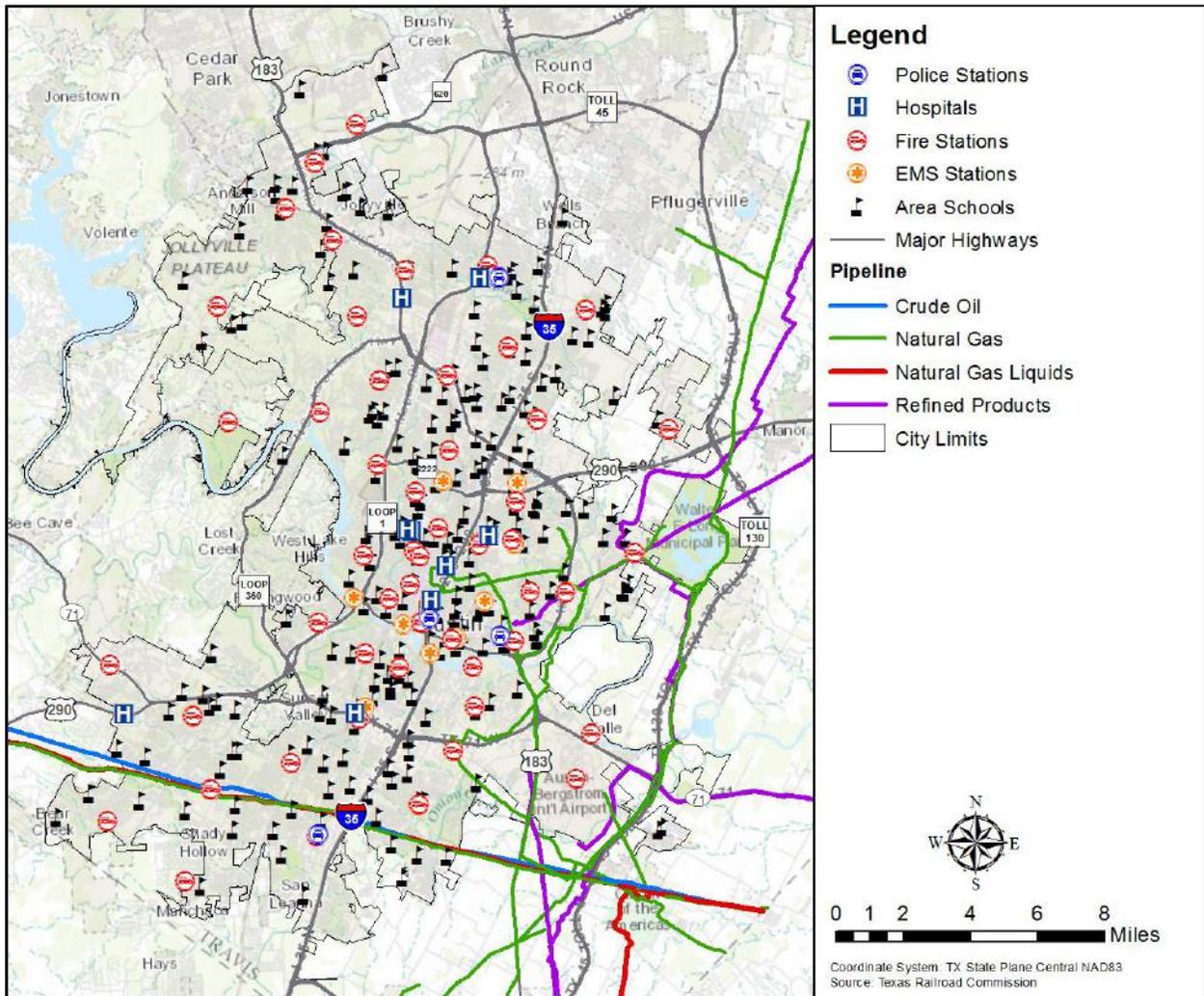
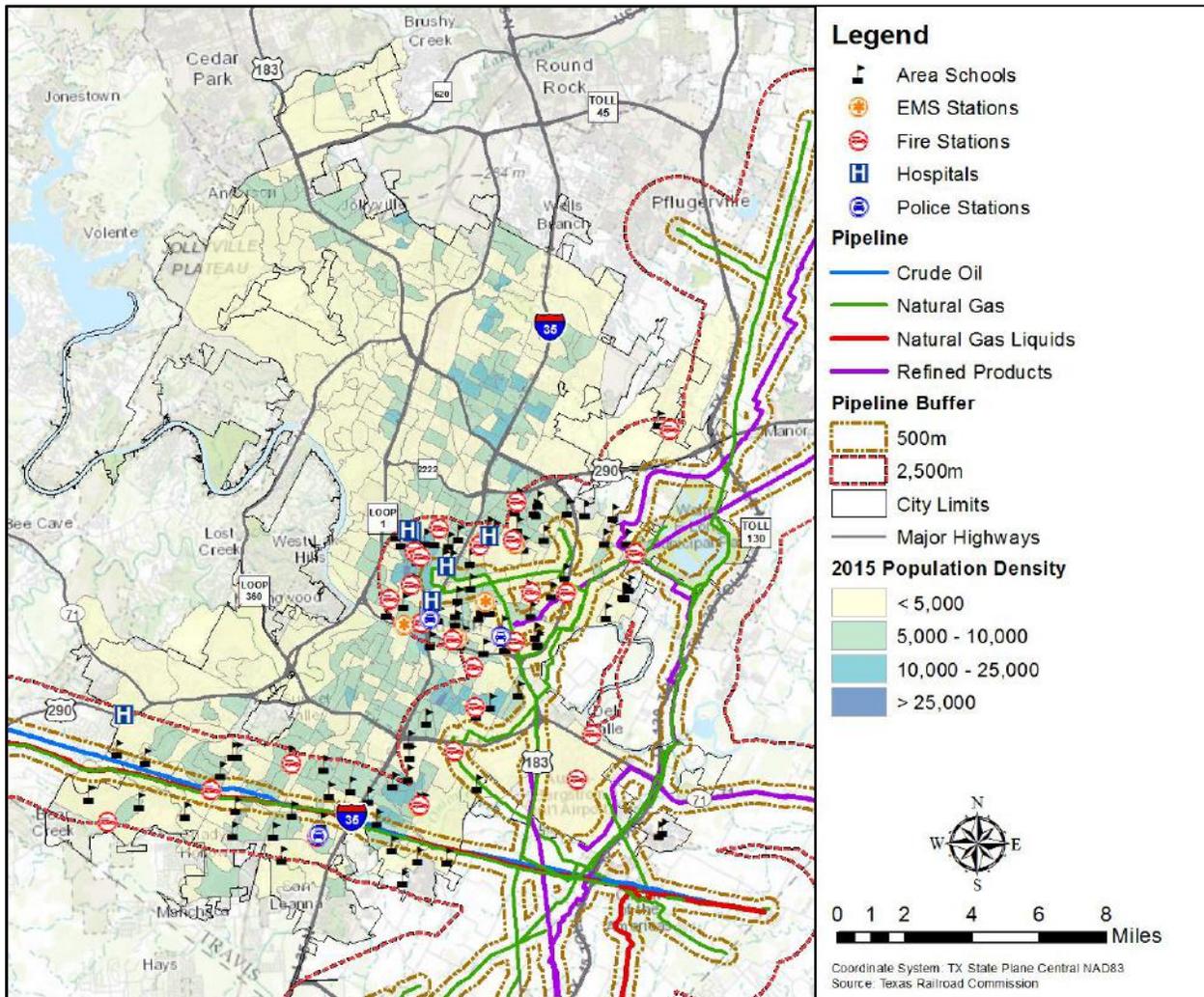


Figure 21-2. Pipelines & Population Density within City of Austin



## Extent

The U.S. Department of Transportation's (DOT) Pipeline and Hazardous Material Safety Administration (PHMSA), acting through the Office of Pipeline Safety (OPS), administers the Department's national regulatory program to assure the safe transportation of natural gas, petroleum, and other hazardous materials by pipeline. The OPS develops regulations and other approaches to risk management to assure safety in design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Since 1986, the pipeline safety program has been funded by a user-fee assessed on a per-mile basis for all pipeline operators that OPS regulates.

The spatial extent of a fuel pipeline breach is "Minimal," expected to affect less than 10% of people and property in Austin.

## Section 21: Pipeline Failure

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### Historical Occurrences

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Pipeline failure events can be caused by corrosion, equipment failure, damage from excavations, incorrect operation, and natural forces. Incidents are generally categorized by severity and type of affected pipeline system component.

The PHMSA defines significant events as those incidents reported by pipeline operators when any of the following occur:

1. Fatality or injury requiring in-patient hospitalization;
2. \$50,000 or more in total costs, measured in 1984 dollars;
3. Highly volatile liquid releases of 5 barrels or more, or other liquid releases of 50 barrels or more; and
4. Liquid releases resulting in an unintentional fire or explosion.

The PHMSA defines a serious pipeline incident as an event involving a fatality or injury requiring in-patient hospitalization.

**Table 21-1. Historical Pipeline Events, 2004 – 2014**

LOCATION	INCIDENT DATE	TYPE	INJURIES	DEATHS	OPERATOR
Austin	03/05/2004	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
Austin	07/18/2005	Gasoline	0	0	MAGELLAN PIPELINE COMPANY, L.P.
Austin	01/11/2007	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
Austin	05/03/2007	Natural Gas	0	0	TEXAS COMMUNITY PROPANE, LTD.
Austin	02/02/2009	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
Austin	03/05/2009	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
Austin	03/17/2009	Natural Gas	0	0	TEXAS GAS SERVICE COMPANY
Austin	01/09/2012	Natural Gas	1	1	TEXAS GAS SERVICE COMPANY

## Section 21: Pipeline Failure

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LOCATION	INCIDENT DATE	TYPE	INJURIES	DEATHS	OPERATOR
Austin	12/27/2012	Propane Gas	2	1	TEXAS COMMUNITY PROPANE, LTD.
Austin	08/13/2013	Crude Oil	0	0	MAGELLAN PIPELINE COMPANY, LP
Austin	12/03/2014	Gas	0	0	TEXAS GAS SERVICE COMPANY, A DIVISION OF ONE GAS, INC.

More information on historical incidents:

- October 8, 1959. A 10 inch propane pipeline burst in Austin, Texas. 400 families had to be evacuated due to the explosion and fire hazard. Eventually, the fumes dissipated without incident. The rupture was caused by a weak section of pipe.
- February 22, 1973. In Austin, Texas, a 19 inch natural gas liquids (NGL) pipeline ruptured due to an improper weld. A passing truck appeared to set off a vapor cloud explosion and fire. Six people were killed, and 2 others injured.
- January 9, 2012. A man was killed, and another person injured, in a fiery house explosion in Austin, Texas, from a leaking 4-inch cast iron gas main installed in 1950. Gas had been smelled in the area for several weeks prior to this. Gas company crews had looked along the affected property for a leak, but were unable to find it.
- August 14, 2013. A leak developed on a valve on Longhorn Pipeline in Austin, Texas during maintenance, spilling about 300 gallons of crude oil. There were no evacuations.

## Probability of Future Events

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The likelihood or future probability of occurrence of a pipeline failure in the City of Austin is low, with more than a 25 percent chance of an event occurring in a given year.

## Vulnerability and Impact

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The analysis for gas pipelines is for natural gas and the analysis for oil pipelines is for natural gas liquids. The immediate and primary area of impact for both types of pipeline events is a 500-meter buffer. The secondary area of impact for both types of pipeline events is a 2,500-meter buffer. Both types of impact can inflict substantial damage on the surrounding areas. These buffer areas are depicted above, in Figure 21-2. The severity of impact depends on a variety of factors, including type of pipeline and volume released; weather conditions; prevailing winds; time of day; and presence of ignition source. Pipeline breaches have the potential to cause multiple deaths and complete shutdown of facilities for 30 days or more.

## Section 21: Pipeline Failure

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Pipelines traverse the watersheds that supplies water to the City, including those that supply water to well-dependent residents and environmentally-sensitive areas such as Barton Springs and the Edwards Aquifer. A leak or spill from these pipelines could threaten neighborhoods, contaminate water supplies, or pollute environmentally-sensitive land. A pipeline accident could have a major impact by causing injuries that result in death or permanent disability or completely shutting down critical facilities.

Pipeline failure can have a “major” impact on human health and area properties. Pipeline failure events can cause injuries, illnesses, and result in permanent disability. These events can also cause facilities in the City planning area to shut-down for at least two weeks and cause more than twenty-five percent of affected properties to be destroyed or suffer major damage.

# Section 22: Mitigation Strategy

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## Mitigation Goals

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Based on the results of the risk and capability assessments, the Planning Team developed and prioritized the mitigation strategy. This involved utilizing the results of both assessments and reviewing the goals and objectives that were included in the previous 2010 Plan.

At the Mitigation Workshop in August 2015, Planning Team members reviewed the mitigation strategy from the previous 2010 Plan. The consensus among all members present was that the strategy developed for the 2010 Plan did not require changes, as it identified overall improvements to be sought in the Plan Update. However, the order and priority of the goals and objectives were reorganized.

### Goal 1

Protect public health and safety.

#### Objective 1.1

Advise the public about health and safety precautions to guard against injury and loss of life from hazards.

#### Objective 1.2

Maximize utilization of the latest technology to provide adequate warning, communication, and mitigation of hazard events.

#### Objective 1.3

Reduce the danger to, and enhance protection of, high risk areas during hazard events.

#### Objective 1.4

Protect critical facilities and services.

### Goal 2

Build and support local capacity and commitment to continuously become less vulnerable to hazards.

#### Objective 2.1

Build and support local partnerships to continuously become less vulnerable to hazards.

## Section 22: Mitigation Strategy

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### Objective 2.2

Build a cadre of committed volunteers to safeguard the community before, during, and after a disaster.

### Objective 2.3

Build hazard mitigation concerns into City planning and budgeting processes.

### Goal 3

Increase public understanding, support, and demand for hazard mitigation.

### Objective 3.1

Heighten public awareness regarding the full range of natural and man-made hazards the public may face.



### Objective 3.2

Educate the public on actions they can take to prevent or reduce the loss of life or property from all hazards and increase individual efforts to respond to potential hazards.

### Objective 3.3

Publicize and encourage the adoption of appropriate hazard mitigation measures.

### Goal 4

Protect new and existing properties.

### Objective 4.1

Reduce repetitive losses to the National Flood Insurance Program (NFIP).

### Objective 4.2

Use the most cost-effective approach to protect existing buildings and public infrastructure from hazards.

### Objective 4.3

Enact and enforce regulatory measures to ensure that future development will not put people in harm's way or increase threats to existing properties.

### Goal 5

Maximize the resources for investment in hazard mitigation.

### Objective 5.1

Maximize the use of outside sources of funding.

### Objective 5.2

Maximize participation of property owners in protecting their properties.

## Section 22: Mitigation Strategy

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### Objective 5.3

Maximize insurance coverage to provide financial protection against hazard events.

### Objective 5.4

Prioritize mitigation projects, based on cost-effectiveness and sites facing the greatest threat to life, health and property.

### Goal 6

Promote growth in a sustainable manner.

### Objective 6.1

Incorporate hazard mitigation activities into long-range planning and development activities.

### Objective 6.2

Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.



### Objective 6.3

Utilize regulatory approaches to prevent creation of future hazards to life and property.

# Section 23: Previous Actions

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Summary.....	1
City of Austin.....	2

## Summary

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Planning Team members were given copies of the previous mitigation actions submitted in the 2010 Plan at the mitigation workshop. The City of Austin reviewed the previous actions and provided an analysis as to whether the action had been completed, should be deferred as an ongoing activity, or be deleted from the Plan. The actions from the 2010 Plan are included in this section as they were written in 2010, with the exception of the “2015 Analysis” section.

City of Austin

City of Austin (Past Action) – 1	
<b>Proposed Action:</b>	Develop a geospatially coded tool that will allow users to: use climate-related EPHI (environmental public health indicator) surveillance to plan and prioritize environmental management decisions and policy changes related to climate change; track the likely impact of policy decisions over temporal and geographic scales; assess progress toward protecting public health; and, trigger emergency alerts when identified key variables coincide.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas Travis County, Texas
<b>History of Damages:</b>	<b>Extreme Heat:</b> 8 mortalities from 1999-2000 reported to NCDC. 9 mortalities in 2002-2004 reported by TX Dept of State Health Services Department of Health Statistics. <b>Flood:</b> 4 mortalities, 61 injuries, \$590K property damage from 2001-2007 reported to NCDC.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Flood, Wildland Fire, Drought, Extreme Heat
<b>Effect on new/existing buildings:</b>	Extreme heat can compromise the habitability of buildings with little or no insulation, no radiant barrier, and/or lacking air conditioning. Flooding can cause structural and moisture damage.
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$500,000
<b>Potential Funding Sources:</b>	US EPA
<b>Lead Agency/Department Responsible:</b>	Austin/Travis County Department of Health and Human Services
<b>Target Completion Date:</b>	2011-2013

2015 Analysis:
<b>Completed</b> – The Travis County Health and Human Services Department (HHSD) currently conducts public health surveillance on heat-related illness and mortality. This completed mitigation action did not include HHSD Epidemiology or emergency preparedness staff responsible for conducting public health surveillance. HHSD Epidemiology and Health Statistics Unit utilizes other analytical methods to assess the impact of heat on the community.* See new Action Item #1.

Section 23: Previous Actions

City of Austin (Past Action) – 2	
<b>Proposed Action:</b>	<b>Establish new data gathering techniques and data sharing agreements across departments to improve environmental public health surveillance.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas Travis County, Texas
<b>History of Damages:</b>	<b>Extreme Heat:</b> 8 mortalities from 1999-2000 reported to NCDC. 9 mortalities in 2002-2004 reported by TX Dept of State Health Services Department of Health Statistics. <b>Flooding:</b> 4 mortalities, 61 injuries, \$590K property damage from 2001-2007 reported to NCDC.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Flood, Wildland Fires, Drought, Extreme Heat
<b>Effect on new/existing buildings:</b>	Extreme heat can compromise the habitability of buildings with little or no insulation, no radiant barrier, and/or lacking air conditioning. Flooding can cause structural and moisture damage.
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$500,000 - \$2,000,000
<b>Potential Funding Sources:</b>	US EPA
<b>Lead Agency/Department Responsible:</b>	Austin/Travis County Department of Health and Human Services
<b>Target Completion Date:</b>	2011-2013

2015 Analysis:
<b>Completed</b> – HHSD uses syndromic surveillance data and mortality data to assess the impact from extreme weather. Data are summarized and distributed as defined in the City of Austin Heat Plan.

Section 23: Previous Actions

City of Austin (Past Action) – 3	
<b>Proposed Action:</b>	Implement urban heat island mapping.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Map pockets of heat throughout the area in Travis County to see where measures need to be taken to reduce the heat impact.
<b>History of Damages:</b>	Seasonal extreme temperature for the city leads to harmful effects to health.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Extreme Heat
<b>Effect on new/existing buildings:</b>	Potential for reflective or green roofs to keep existing buildings cool.
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	Austin Climate Protection Program (ACPP)
<b>Target Completion Date:</b>	Eighteen months after receipt of funding

2015 Analysis:
<i>Delete Action – Action was not completed. There is no process to use the data if gathered, gathering the data would negatively alter the operations of..., and therefore this exercise would not be useful.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 4	
<b>Proposed Action:</b>	Develop a study to determine the relationship between allergies and climate change.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	Allergies increase as the city experiences more extreme weather, especially extreme heat. The purpose of the study would be to determine the relationship between climate change and the increase in allergies.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Extreme Heat, Infectious Disease, Drought
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	ACPP in coordination with the Health Dept. and UT
<b>Target Completion Date:</b>	Twelve months after receipt of funds

2015 Analysis:
<i>Delete Action – Action was not completed. No demand for this information. Allergies are not a mandated notifiable disease condition. Without a specific case definition for “allergies” this condition cannot be tracked or quantified.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 5</b>	
<b>Proposed Action:</b>	Institute a tree planting program to reduce heat island impacts and flood damage.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	The city experiences seasonal flooding and extreme temperature. Planting trees will help reduce floodwaters and also reduce temperatures.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Extreme Heat, Flood
<b>Effect on new/existing buildings:</b>	Planting trees around existing buildings will help keep temperature down as well as reduce energy cost. In addition, trees can help to reduce the effect of floodwaters.
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	ACPP
<b>Target Completion Date:</b>	TBD

<b>2015 Analysis:</b>
<b>Completed</b> – Austin's Urban Forest Plan was adopted by Austin City Council on Thursday March 6th, 2014 which outlines future tree planting goals.

Section 23: Previous Actions

<b>City of Austin (Past Action) – 6</b>	
<b>Proposed Action:</b>	<b>Complete a study to determine the effect thermal comfort/power outages have on people.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	The city experiences high temperatures throughout the summer and is currently experiencing record heat for 2009. Although winters are milder in Austin, power outages are common.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Extreme Heat, Winter Storm
<b>Effect on new/existing buildings:</b>	This action would determine the effect on people rather than property
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	ACPP
<b>Target Completion Date:</b>	TBD

<b>2015 Analysis:</b>
<i>Delete Action – Action was not completed. No demand for this study by any City or AISD departments.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 7</b>	
<b>Proposed Action:</b>	<b>Complete a study for the Capitol Metropolitan region to downscale US climate change models to show climate change impacts expected in our region.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Region-wide
<b>History of Damages:</b>	The city is in a period of record drought for 2009 which leads to wildfires and water shortage.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Extreme Heat, Wildland Fire, Drought, Flood, Infectious Disease
<b>Effect on new/existing buildings:</b>	This action would determine the effect on people rather than property
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	ACPP
<b>Target Completion Date:</b>	2011 and Ongoing

<b>2015 Analysis:</b>
<b>Completed</b> – <i>The Central Texas Extreme Weather and Climate Change Vulnerability Assessment of Regional Transportation Infrastructure was one of 19 Federally sponsored projects nationwide intended to “pilot approaches to conduct climate change and extreme weather vulnerability assessments of transportation infrastructure and to analyze options for adapting and improving resiliency.” The Assessment was led by the Capital Area Metropolitan Planning Organization, or CAMPO, in partnership with the City of Austin, and features the contributions of other state, regional, and local entities.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 8	
<b>Proposed Action:</b>	Develop a study to determine the relationship between infectious disease and climate change.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	No history currently, but as we start to see climate change impacts in our region it would be useful to develop a study to prepare for potential increases in infectious diseases.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Extreme Heat, Infectious Disease, Drought
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	ACPP in coordination with the Health Dept. and UT
<b>Target Completion Date:</b>	Twelve months after receipt of funds

2015 Analysis:
<b>Completed</b> – <i>The Health Department does track infectious diseases (specifically arboviruses) that could be affected by extreme weather.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 9	
<b>Proposed Action:</b>	<b>Develop Community Wildfire Protection Plan for the City of Austin and/or surrounding communities.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	City of Austin and surrounding communities/natural areas.
<b>History of Damages:</b>	There is limited data on the damages resulting from wildfires and few damaging wildfires have been identified, however the potential is generally accepted to be moderate to high.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Wildland Fire
<b>Effect on new/existing buildings:</b>	Increased protection of new and existing structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	Dependent on design - \$200,000 for contract-reduced direct cost if done by city staff
<b>Potential Funding Sources:</b>	Dependent on design - Department budgets and/or grants
<b>Lead Agency/Department Responsible:</b>	Dependent on design – AFD, HSEM. and/or interagency working group
<b>Target Completion Date:</b>	Dependent on design – 6 months to 1 year

2015 Analysis:
<b>Completed</b> – <i>The Community Wildfire Protection Plan (CWPP) was developed in a collaborative manner and adopted by Austin and Travis County.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 10	
<b>Proposed Action:</b>	Establish an interdepartmental/interagency wildland fuels crew to implement mechanical fuel reduction projects, conduct prescribed burns, and suppress wildland fires.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	City of Austin and surrounding communities/natural areas
<b>History of Damages:</b>	There is limited data on the damages resulting from wildfires and few damaging wildfires have been identified, however the potential is generally accepted to be moderate to high.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Wildland Fire
<b>Effect on new/existing buildings:</b>	Increased protection on new/existing structures
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Dependent on design - 6 person crew - \$500,000/yr plus \$200,000 startup expenses
<b>Potential Funding Sources:</b>	Dependent on design - Department budgets and/or external partners
<b>Lead Agency/Department Responsible:</b>	Dependent on design – Wildland fire management agency that follows the National Wildfire Coordinating Group (NWCG) standards
<b>Target Completion Date:</b>	Dependent on design – multi-year, year round

2015 Analysis:
<b>Completed</b> – <i>The Austin Fire Department established a Wildfire Mitigation Division to address hazardous fuels reduction including mechanical Fuel Reduction projects, Prescribed Burns and Wildland Fire Suppression.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 11</b>	
<b>Proposed Action:</b>	<b>Establish a position for an interdepartmental/interagency wildland fire and/or wildland urban interface program coordinator.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	City of Austin and surrounding communities/natural areas
<b>History of Damages:</b>	There is limited data on the damages resulting from wildfires and few damaging wildfires have been identified, however the potential is generally accepted to be moderate to high.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Wildland Fire
<b>Effect on new/existing buildings:</b>	Increased protection on new/existing Structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	Dependent on design - \$150,000/yr
<b>Potential Funding Sources:</b>	Dependent on design - Department budgets and/or external partners
<b>Lead Agency/Department Responsible:</b>	Dependent on design – AFD, HSEM, or wildland fire management agency that follows NWCG standards
<b>Target Completion Date:</b>	Dependent on design – multi-year, year round

<b>2015 Analysis:</b>
<b>Completed</b> – <i>The Austin Fire Department established a Wildfire Mitigation Division which includes a Wildfire Mitigation Program Manager position that is equivalent to a Wildland Urban Interface (WUI) program Coordinator.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 12</b>	
<b>Proposed Action:</b>	<b>Expand the capability of the city’s communication system for citizens.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	The City has a 24-hour notification system, but a new system is needed that is more interactive. The new system will allow citizens to review documents and respond to the City. This system would provide efficient/user-friendly site without a webmaster.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Dam Failure, Drought, Extreme Heat, Flood, Hail, Hazardous Material Release, Hurricane Wind, Infectious Disease, Pipeline Failure, Tornado, Thunderstorm, Terrorism, Wildland Fire, Winter Storm
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	N/A
<b>Estimated Cost:</b>	\$100,000
<b>Potential Funding Sources:</b>	Grant funds for a pilot program
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Target Completion Date:</b>	2009 and ongoing

<b>2015 Analysis:</b>
<i>Completed.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 13	
<b>Proposed Action:</b>	Conduct a large-scale public education program on the home care and treatment of individuals and family members during a pandemic influenza.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	Pandemics have occurred in 1918, 1956, 1967 and 2009.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Infectious Disease
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	Unknown
<b>Potential Funding Sources:</b>	FEMA and CDC grants
<b>Lead Agency/Department Responsible:</b>	HSEM, HHSD
<b>Target Completion Date:</b>	September 2009

2015 Analysis:
<b>Completed</b> – <i>The City of Austin Office of Homeland Security and Emergency Management (HSEM) distributes public information on ways to prevent the flu, through their annual preparedness calendar.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 14</b>	
<b>Proposed Action:</b>	<b>Construct a multi-purpose structure that could provide an ongoing commercial purpose until needed, at which point it could be re-configured as a disaster-safe shelter.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Downtown Austin
<b>History of Damages:</b>	The City has routinely opened shelters as a result of a CASHP activation and winter weather events.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Extreme Heat, Infectious Disease, Winter Storm
<b>Effect on new/existing buildings:</b>	May require new construction as well as the demolition of existing structures depending on the ultimate location of the facility
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$10,000,000 to \$15,000,000
<b>Potential Funding Sources:</b>	Grants and private funding
<b>Lead Agency/Department Responsible:</b>	Building Services
<b>Target Completion Date:</b>	18 months after receipt of funds

<b>2015 Analysis:</b>
<i>Delete Action.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 15</b>	
<b>Proposed Action:</b>	<b>Retrofit AISD facilities for wind resistance/safe room.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	AISD locations and critical facilities
<b>History of Damages:</b>	AISD area schools housed evacuees from Hurricane Ike and also were minimally damaged from hurricane winds. Stronger windows are needed to resist hurricane winds and also damage from hail, ice or flooding during a hazard event.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Hurricane Wind, Tornado, Winter Storm, Hail, Thunderstorm, Flood
<b>Effect on new/existing buildings:</b>	This action would strengthen current buildings by making them more resistant to hurricane and high winds.
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Federal and state grants
<b>Lead Agency/Department Responsible:</b>	AISD – Office of Homeland Security and Emergency Management
<b>Target Completion Date:</b>	2010-2011

<b>2015 Analysis:</b>
<i>Defer Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 16</b>	
<b>Proposed Action:</b>	<b>Develop an AISD center that will also function as a disaster-safe shelter.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	To be determined
<b>History of Damages:</b>	During Hurricane Ike, Austin area schools housed evacuees. Supplies were short and also there was not enough available space. A disaster-safe shelter could provide room for evacuees, a shelter for the Austin community, and also function as an auditorium or gym for AISD.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Dam Failure, Flood, Hail, Hazardous Material Release, Hurricane Wind, Infectious Disease, Thunderstorm, Terrorism, Tornado, Wildland Fire, Winter Storm
<b>Effect on new/existing buildings:</b>	This action would allow for more efficient use of current buildings as well as the development of a new shelter
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$2,500,000
<b>Potential Funding Sources:</b>	Federal and state grants
<b>Lead Agency/Department Responsible:</b>	AISD – Office of Homeland Security and Emergency Management
<b>Target Completion Date:</b>	2010-2011

<b>2015 Analysis:</b>
<i>Defer Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 17</b>	
<b>Proposed Action:</b>	<b>Develop an awareness campaign for extreme temperature and promote through the City of Austin Website, home safe calendar and pamphlets to neighborhood associations.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	Because the city experiences mild winter, many residents do not properly protect their property or enact home mitigation measures. In addition the city experience extreme heat every summer. Heat strokes and even fatalities can occur if citizens are unaware of the dangers of extreme heat.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Extreme Heat, Winter Storm
<b>Effect on new/existing buildings:</b>	Retrofit existing structures and construct new structures with double pane windows and other methods to reduce effects of extreme heat and winter storm
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$5,000 annually
<b>Potential Funding Sources:</b>	Federal and state grants/ general revenue
<b>Lead Agency/Department Responsible:</b>	HSEM, Public Health Dept., EMS
<b>Target Completion Date:</b>	2010 and ongoing

<b>2015 Analysis:</b>
<b>Completed</b> – <i>HSEM produces and distributes a highly popular calendar and children’s workbook to the public, that promotes the concept of extreme heat awareness.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 18</b>	
<b>Proposed Action:</b>	<b>Develop a safe room program to retrofit residences in order to protect against a tornado or hurricane wind event.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	To be determined
<b>History of Damages:</b>	During Hurricane Ike, the City experienced high winds and often is prone to mild tornados which cause damage to buildings and property and threaten the safety of citizens.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Tornado, Hurricane Wind
<b>Effect on new/existing buildings:</b>	This action would strengthen existing buildings and residences by making them more resistant to damage from tornadoes and hurricane winds
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$6,000 per safe room
<b>Potential Funding Sources:</b>	Federal Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Target Completion Date:</b>	To be implemented after receipt of funds

<b>2015 Analysis:</b>
<i>Defer Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 19</b>	
<b>Proposed Action:</b>	<b>Conduct public awareness campaign for realtors, insurance agents, lenders, surveyors and other professionals on benefits of flood insurance under the National Flood Insurance Program (NFIP).</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. The NFIP benefits those who have purchased flood insurance for their homes. More training is needed regarding policies for agents, lenders and other professionals.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Flood, Thunderstorm
<b>Effect on new/existing buildings:</b>	This action would reduce the impact of flooding for existing and new structures
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Staff time
<b>Potential Funding Sources:</b>	General Revenue
<b>Lead Agency/Department Responsible:</b>	Partner with other associations and groups currently providing NFIP training
<b>Target Completion Date:</b>	Ongoing

<b>2015 Analysis:</b>
<i>Ongoing Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 20</b>	
<b>Proposed Action:</b>	<b>Increase public awareness regarding the National Flood Insurance Program (NFIP) and Preferred Risk Policy for residents outside of the Special Flood Hazard Area (SFHA).</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. Flood insurance provides protection to those who have purchased flood insurance for their homes. Over 30% of NFIP claims occur outside of the SFHA.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Flood, Thunderstorm
<b>Effect on new/existing buildings:</b>	This action would result in stronger buildings if citizens purchased flood insurance
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$5,000 per year
<b>Potential Funding Sources:</b>	Grants and general revenue
<b>Lead Agency/Department Responsible:</b>	HSEM – partnering with organizations providing free NFIP training where available.
<b>Target Completion Date:</b>	Annually

<b>2015 Analysis:</b>
<i>Ongoing Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 21</b>	
<b>Proposed Action:</b>	Install perimeter lighting at Tom Miller, Decker and Longhorn Dam.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Tom Miler Dam – 20.294°N, 97.786°W Decker Dam – 30.285°N, 97.597°W Longhorn Dam – 30.250° N, 97.714°W
<b>History of Damages:</b>	The city has not experienced a major dam failure since the early 1930s. Perimeter lighting would help increase security at the above locations.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Dam Failure, Terrorism
<b>Effect on new/existing buildings:</b>	Prevent flood damage to existing structures within the inundation area for each dam
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Target Completion Date:</b>	2011

<b>2015 Analysis:</b>
<i>Defer Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 22</b>	
<b>Proposed Action:</b>	<b>Strengthen access restrictions at Tom Miller, Decker and Longhorn Dam.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Tom Miler Dam – 20.294°N, 97.786°W Decker Dam – 30.285°N, 97.597°W Longhorn Dam – 30.250° N, 97.714°W
<b>History of Damages:</b>	Although the last major dam failure occurrence for the City was the result of a flood in the 1930s, access restrictions are necessary in light of concerns for terrorism since 9/11.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Dam Failure, Terrorism
<b>Effect on new/existing buildings:</b>	Prevent flood damage to existing structures within the inundation area for each dam
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Target Completion Date:</b>	2011

<b>2015 Analysis:</b>
<i>Defer Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 23	
<b>Proposed Action:</b>	<b>Purchase communication equipment for uniform communication capability among first responders in the event of a pipeline failure or hazardous material spill.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	The city does not have radio equipment that would be safe to use to communicate nearby a hazardous material release or pipeline failure. Technology is currently available for radios that would allow for communication even in a volatile environment.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Pipeline Failure, Hazardous Material Release, Terrorism
<b>Effect on new/existing buildings:</b>	This action enhances communicability between responders and does not directly impact new/existing buildings
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Target Completion Date:</b>	2010-2011 with replacements as needed

2015 Analysis:
<i>Defer Action – Will include in 2015 Plan Update. Should consider expanding partners to assist with the implementation of this action, such as AFD HazMat and CTM Wireless.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 24</b>	
<b>Proposed Action:</b>	Increase public awareness of the dangers of pipeline failure through the Pipeline Safety Trust, a NFP Public charity in order to promote fuel transportation safety.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	Pipeline failure may occur due to ruptures or terrorism.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Pipeline Failure, Terrorism
<b>Effect on new/existing buildings:</b>	This action does not directly affect new/existing buildings
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Staff time
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Target Completion Date:</b>	2011

<b>2015 Analysis:</b>
<i>Defer Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 25	
<b>Proposed Action:</b>	Develop a public awareness campaign to encourage citizens to purchase NOAA weather radios.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	NOAA weather radios keep citizens informed in the event of a natural disaster. These radios are available for purchase at many locations throughout the city, such as HEB.

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Thunderstorm, Hail, Flood, Tornado, Hurricane Wind, Winter Storm
<b>Effect on new/existing buildings:</b>	NOAA radios allow citizens to take measures to protect their property and existing buildings in the event of a natural disaster
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Minimal
<b>Potential Funding Sources:</b>	General Fund
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Target Completion Date:</b>	To be implemented annually

2015 Analysis:
<b>Completed</b> – Information on NOAA weather radios is included in the publicly distributed HSEM calendar and children’s workbook.

Section 23: Previous Actions

<b>City of Austin (Past Action) – 26</b>	
<b>Proposed Action:</b>	<b>Conduct study to determine specific buildings and critical facilities that could be upgraded to Green Building Status.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	To be determined
<b>History of Damages:</b>	In 2007 the National Association of Home Builders (NAHB) and the International Code Council (ICC) partnered to form to establish a much-needed and nationally-recognizable standard definition of what is meant by "Green Building". This would help buildings to conserve energy, but also make critical facilities more resistant to natural hazards.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Thunderstorm, Hail, Extreme Heat, Winter Storm, Tornado, Flood
<b>Effect on new/existing buildings:</b>	This would increase energy savings and costs for existing buildings, but also affect the development of new buildings, as they are built to a higher standard
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	To be determined based on the study results
<b>Potential Funding Sources:</b>	City funds, Grants
<b>Lead Agency/Department Responsible:</b>	Building Services / Green Building
<b>Target Completion Date:</b>	Complete study by 2011

<b>2015 Analysis:</b>
<i>Delete Action.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 27</b>	
<b>Proposed Action:</b>	<b>Promote the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) through the City of Austin’s Public Awareness Week.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Outlying and rural areas of the City of Austin
<b>History of Damages:</b>	Although the City experiences little snow, it is often prone to floods and hail events, the most recent in the Spring of 2009.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Hail, Thunderstorm, Winter Storm
<b>Effect on new/existing buildings:</b>	This action would help for monitoring rain and hail events to better report historical occurrences; thereby identifying areas and existing buildings that are not properly protected
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Negligible
<b>Potential Funding Sources:</b>	General Revenue
<b>Lead Agency/Department Responsible:</b>	Watershed Department in conjunction with the National Weather Service
<b>Target Completion Date:</b>	Annually – every March

<b>2015 Analysis:</b>
<b>Completed</b> – Along with cooperation from the National Weather Service and Texas Floodplain Managers Association, the City of Austin has promoted CoCoRaHS at outreach events such as SkyWarn, WeatherFest, and other events.

Section 23: Previous Actions

<b>City of Austin (Past Action) – 28</b>	
<b>Proposed Action:</b>	<b>Install additional flashing lights at low water crossings at areas additionally annexed to the City.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	There have been several low water crossing areas that were recently annexed to Austin. The following locations need flashing warning lights: 10140 Old San Antonio Road, 6100 W. Slaughter, 10100 David Moore Drive, 9708 Carson Creek Boulevard, 600 block of W. Dittmar at Cooper Lane (single lane bridge crossing), Slaughter Creek Drive in the Hollow at Slaughter Creek, Bilbrook Place, E. Dessau Road, 12000 and 12100 Cameron Road, Burleson Road (south of the Bergstrom Airport ), S. Brodie Lane
<b>History of Damages:</b>	Austin experiences torrential floods every year. More warnings are needed at low water crossings to prevent people from driving through dangerous areas.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Thunderstorm, Hail, Flood
<b>Effect on new/existing buildings:</b>	This would protect lives and property, but mainly vehicles rather than buildings.
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	Up to \$10,000 per crossing
<b>Potential Funding Sources:</b>	HMGP, CDBG, PDM grants
<b>Lead Agency/Department Responsible:</b>	Watershed Dept.
<b>Target Completion Date:</b>	To be installed by 2012

<b>2015 Analysis:</b>
<b>Completed</b> – <i>The flashing lights have been installed and successful in alerting drivers to the locations and flooding status of frequently flooded low water crossings.</i>

Section 23: Previous Actions

<b>City of Austin (Past Action) – 29</b>	
<b>Proposed Action:</b>	<b>Create a neighborhood and community plan, including drills and exercises to educate the public regarding the location of pipelines and actions to take in the event of a hazardous material spill.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>History of Damages:</b>	The city has experienced few man-caused events, but citizens should be aware of procedures and locations of hazardous areas.

<b>MITIGATION ACTION DETAILS</b>	
<b>Primary Hazard Addressed:</b>	Pipeline Failure, Hazardous Material Release
<b>Effect on new/existing buildings:</b>	This action primarily concerns protecting lives instead of directly effecting buildings.
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Minimal cost as partnering opportunities are available
<b>Potential Funding Sources:</b>	General Revenue and grants where available
<b>Lead Agency/Department Responsible:</b>	Austin Fire Department; Watershed Protection and Development Services
<b>Target Completion Date:</b>	Ongoing

<b>2015 Analysis:</b>
<i>Defer Action – Will include in 2015 Plan Update.</i>

Section 23: Previous Actions

City of Austin (Past Action) – 30	
<b>Proposed Action:</b>	Develop and implement shelter-in-place training for AISD schools and city buildings to mitigate against hazardous material releases.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Critical infrastructure and schools throughout the city.
<b>History of Damages:</b>	The City has had few spill events and has not been affected by a major occurrence. However employees, students, teachers and citizens should be aware of proper procedures for shelter-in-place

MITIGATION ACTION DETAILS	
<b>Primary Hazard Addressed:</b>	Hazardous Material Release
<b>Effect on new/existing buildings:</b>	This activity would help to protect people in the event of a spill and would not negatively affect existing buildings
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	Minimal
<b>Potential Funding Sources:</b>	Staff time
<b>Lead Agency/Department Responsible:</b>	AISD, Building Services
<b>Target Completion Date:</b>	Ongoing

2015 Analysis:
<b>Completed</b> – Through a table top functional exercise and drill in partnership with members of the pipeline safety industry the action was addressed.

# Section 24: Mitigation Actions

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## Summary

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As discussed in Section 2, at the mitigation workshop the planning team and stakeholders met to developed mitigation actions for each of the natural and man-caused hazards included in the Plan. Each of the actions in this section were prioritized based on FEMA’s STAPLEE criteria, which includes consideration of the social, technical, administrative, political, legal, economic, and environmental factors necessary for the implementation of each action. As a result of this exercise, an overall priority was assigned to each mitigation action.

As part of the economic evaluation of the STAPLEE analysis, jurisdictions analyzed each action in terms of the overall costs, measuring whether the potential benefit to be gained from the action outweighed all costs associated with it. As a result of this exercise, a ranking was assigned to each mitigation action by marking them as High (H), Moderate (M), or Low (L). An action that is ranked as “High” indicates that the action will be prioritized for implementation as funding is received. A “Moderate” action is one that may not be implemented right away depending on the cost and number of citizens served by the action. Actions ranked as “Low” indicate that they may not be implemented until “High” and “Moderate” actions have been completed.

All mitigation actions created by Planning Team members are presented in this section in the form of Mitigation Action Worksheets. More than one hazard is sometimes listed for an action, if appropriate.

City of Austin

<b>City of Austin – Action #1</b>	
<b>Proposed Action:</b>	<b>Educate FloodPro website as a tool for the public to determine if their home or property is in the 100 year floodplain. Teach communities mitigation ideas for flood-proofing their homes.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	City of Austin
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk to properties throughout City from flood, reduce risk to residents in floodplain areas.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood
<b>Effect on new/existing buildings:</b>	This would increase situational awareness about flood risks to homes in Austin
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	General Revenue, HMGP/CDBG/PDM Grants
<b>Lead Agency/Department Responsible:</b>	WPD
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan, Floodplain Management Plan, Flood Response Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #2</b>	
<b>Proposed Action:</b>	<b>Construct additional data centers to continue use of critical systems during a technological disruption.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	To be determined
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	The City is exposed to extended outages due to reliance on only one data center. This data center has several exposures which could result in extended outages, causing total loss of critical systems needed for public safety.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Technological Disruption
<b>Effect on new/existing buildings:</b>	Lack of infrastructure redundancy
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$15-\$30 million
<b>Potential Funding Sources:</b>	HGMP, Homeland Security grants
<b>Lead Agency/Department Responsible:</b>	Communications & Technology Management
<b>Implementation Schedule:</b>	2017-2020
<b>Incorporation into Existing Plans:</b>	Information Technology Strategy

<b>COMMENTS:</b>
Possible purchase/lease and build out of a data center, or leasing space in hosting facility.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 5; Politically Acceptable = 4; Legal = 3; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>City of Austin – Action #3</b>	
<b>Proposed Action:</b>	<b>Move public facing services to the cloud to allow for continuity of services in the event of denial of service attacks (DOS).</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	To be determined
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	The City is exposed to denial of service attacks (DOS). Given that the city has limited resources (network, servers), an extended DOS attack will result in unavailability of services.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Cyber, Terrorism, Technological Disruption
<b>Effect on new/existing buildings:</b>	Single point of attack, limited resources
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	HGMP, Homeland Security grants
<b>Lead Agency/Department Responsible:</b>	Communications & Technology Management
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Information Technology Strategy

<b>COMMENTS:</b>
Reduction of data center requirements.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #4</b>	
<b>Proposed Action:</b>	<b>Provide a Data Loss Protection System to reduce the likeliness of data loss.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	City of Austin
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	The City could experience high costs to remediate data loss of Personally Identifiable Information (PII).
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Cyber, Technological Disruption, Terrorism
<b>Effect on new/existing buildings:</b>	None
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$750,000
<b>Potential Funding Sources:</b>	HGMP, Homeland Security grants
<b>Lead Agency/Department Responsible:</b>	Communications & Technology Management
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Information Technology Strategy

<b>COMMENTS:</b>
Release of sensitive information.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #5</b>	
<b>Proposed Action:</b>	<b>Implement a Security Information and Event Management (SIEM) System.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	City of Austin
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	A SIEM system will provide real-time analysis of security alerts generated by network hardware and applications.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Cyber Attack, Terrorism
<b>Effect on new/existing buildings:</b>	None
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$750,000
<b>Potential Funding Sources:</b>	HGMP, Homeland Security grants
<b>Lead Agency/Department Responsible:</b>	Communications & Technology Management
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Information Technology Strategy

<b>COMMENTS:</b>
Security incidents.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 5; Politically Acceptable = 4; Legal = 3; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>City of Austin – Action #6</b>	
<b>Proposed Action:</b>	<b>Provide a backup site for workers displaced due to a disaster.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	TBD
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	The City currently has very little backup sites for employees displaced due to disaster to their workspace. Contracting with a backup site vendor or providing telework options will provide the City with workspace for displaced employees.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Extreme Heat, Hail, Thunderstorm Wind, Tornado, Winter Storm, Hurricane Wind, Expansive Soils, Drought, Flood, Wildfire, Dam Failure, Hazardous Materials, Terrorism, Pipeline Failure, Infectious Disease, Cyber, Technological Disruption
<b>Effect on new/existing buildings:</b>	None
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$100,000-\$500,000
<b>Potential Funding Sources:</b>	HGMP, Homeland Security grants
<b>Lead Agency/Department Responsible:</b>	Communications & Technology Management
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
Security incidents.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #7</b>	
<b>Proposed Action:</b>	<b>Share information about threats with other entities to provide early identification of attacks on the City's technology infrastructure.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	TBD
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Sharing threats with other entities will provide early identification of attacks on the City's technology infrastructure.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Cyber, Terrorism, Technological Disruption
<b>Effect on new/existing buildings:</b>	None
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$100,000/yr.
<b>Potential Funding Sources:</b>	HGMP, Homeland Security grants
<b>Lead Agency/Department Responsible:</b>	Communications & Technology Management
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Information Technology Strategy

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #8</b>	
<b>Proposed Action:</b>	<b>Conduct heat surveillance using bio-surveillance tools to plan, prioritize and mitigate risks related to climate change; guide environmental management decisions and policy changes; establish triggers for emergency alerts.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Data is available for Central Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduces risk to public health and welfare.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Extreme Heat
<b>Effect on new/existing buildings:</b>	Extreme heat can compromise the habitability of buildings with little or no insulation, no radiant barrier, and/or lacking air conditioning
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	US EPA
<b>Lead Agency/Department Responsible:</b>	Department of Health and Human Services
<b>Implementation Schedule:</b>	2016-2019
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 5; Politically Acceptable = 4; Legal = 3; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>City of Austin – Action #9</b>	
<b>Proposed Action:</b>	<b>Monitor zoonotic diseases thought to be associated with changes in weather conditions and climate change, and inform the public of any changes so they can better protect themselves.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin/Travis County
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Prepare for potential increases in infectious diseases.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Infectious Diseases
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	Department of Health and Human Services
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #10</b>	
<b>Proposed Action:</b>	<b>Have a workshop on ways to retrofit historic homes to mitigate weather related hazards.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Educate residents and give them resources on how to retrofit their existing home to mitigate potential effects.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Thunderstorm Wind, Drought, Extreme Heat, Winter Storm, Tornado, Hail, Hurricane Wind, Wildfire, Dam Failure
<b>Effect on new/existing buildings:</b>	Educate residents and encourage them to implement mitigation actions on their own properties
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	City, Texas Historic Commission (Certified Local Government Grant), Preservation Austin
<b>Lead Agency/Department Responsible:</b>	Planning and Zoning, Historic Preservation
<b>Implementation Schedule:</b>	2015-2020
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

Section 24: Mitigation Actions

<b>City of Austin – Action #11</b>	
<b>Proposed Action:</b>	<b>Survey and map historic resources within flood prone areas. Design review and site plan review can lead to new construction that is both disaster-resistant and adheres to the scale, setting, materials, and sense of place of a particular historic district. By implementing Regulatory actions (such as planning and zoning) this will provide an opportunity to ensure that future growth and development avoid or minimize risk of hazard-related damage to the historical property.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Help identify properties that already have historic designation, as well as those that are eligible, that are threatened by potential risks.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Thunderstorm Wind
<b>Effect on new/existing buildings:</b>	Identify existing historic buildings that are threatened by flooding
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	City, Texas Historic Commission (Certified Local Government Grant)
<b>Lead Agency/Department Responsible:</b>	Planning and Zoning, Historic Preservation
<b>Implementation Schedule:</b>	2015-2020
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 5; Politically Acceptable = 4; Legal = 3; Economically Sound = 5; and Environmentally Sound = 4

Section 24: Mitigation Actions

<b>City of Austin – Action #12</b>	
<b>Proposed Action:</b>	Create a grant or rebate program to encourage energy retrofitting buildings within areas that are designated as Historic to encourage energy retrofitting that is compatible to historic properties. These mitigation efforts would include integrating a fire protection system with sprinklers; retrofitting windows for cold/heat and wind resistance to include shatter-resistant glass and ensure they are properly sealed. Attach guards to AC units for hail and tornado. Replace all toilets with low-flow toilets to help preserve water, especially for drought. For expansive soils, a perimeter apron can be applied around the structure to focus on drainage-control strategies to keep the soils within an acceptable range of moisture content.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	This would help with Water Conservation and Energy Conservation as well as reduce potential property damage during extreme weather events.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Thunderstorm Wind, Drought, Extreme Heat, Winter Storm, Tornado, Hail, Hurricane Wind, Expansive Soils
<b>Effect on new/existing buildings:</b>	Encourage retrofitting of historic buildings to reduce water and energy consumption
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	City, Austin Energy
<b>Lead Agency/Department Responsible:</b>	Planning and Zoning, Historic Preservation
<b>Implementation Schedule:</b>	2015-2020
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

## Section 24: Mitigation Actions

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<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #13</b>	
<b>Proposed Action:</b>	<b>Structurally retrofit existing City of Austin facilities including, but not limited to, libraries and recreation facilities to serve as hardened shelters in the event of hazardous weather, extreme heat or winter storms.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce loss of lives, reduce cost to repair facilities.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Thunderstorm Wind, Hail, Tornado, Winter Storm, Hurricane Wind, Extreme Heat
<b>Effect on new/existing buildings:</b>	This action would require new and existing City facilities to be strengthened to better resist extreme weather conditions
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Federal/State grants and general revenue
<b>Lead Agency/Department Responsible:</b>	Building Services, Parks and Recreation Department (PARC), Austin Public Libraries, HSEM
<b>Implementation Schedule:</b>	Ongoing
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
Submitted by R. Scott Swearingin, HSEM
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #14</b>	
<b>Proposed Action:</b>	Implement mitigation strategies that would strengthen and retrofit existing, pre-identified City of Austin facilities that serve as intermediate shelters, to include replacing windows with shatter-proof glass, upgrading fire systems, reinforcing wall and foundation connections, and other mitigation activities as required.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce loss of lives, reduce cost to repair facilities.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure & Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Hail, Tornado, Flood, Wildfire, Dam Failure, Hazardous Materials, Pipeline Failure
<b>Effect on new/existing buildings:</b>	This action would require new and existing City facilities to be designed to better withstand severe weather and to include redundancies such as generators
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Federal/State grants and general revenue
<b>Lead Agency/Department Responsible:</b>	Building Services, Parks and Recreation Department (PARD), HSEM
<b>Implementation Schedule:</b>	Ongoing
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
Submitted by Billy Atkins, HSEM
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #15</b>	
<b>Proposed Action:</b>	Create and implement a component of the City of Austin Business Recovery Plan that will educate private business on the hazards the City is subject to and assist them with the identification of methods to mitigate the impact of those hazards on their business. This will help educate business owners on mitigation strategies that will make their properties more hazard resistant.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Educate businesses to reduce loss of life and property.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education & Awareness Programs

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Extreme Heat, Hail, Thunderstorm Wind, Tornado, Winter Storm, Hurricane Wind, Expansive Soils, Drought, Flood, Wildfire, Dam Failure, Hazardous Materials, Terrorism, Pipeline Failure, Infectious Disease, Cyber, Technological Disruption
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Federal/State grants and general revenue
<b>Lead Agency/Department Responsible:</b>	HSEM and Economic Development Department
<b>Implementation Schedule:</b>	Ongoing
<b>Incorporation into Existing Plans:</b>	Business Recovery Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #16</b>	
<b>Proposed Action:</b>	Modify the existing structure and make improvements to allow proper draining of excess rainwater away from the facility, such as installing a French Drain, which is basically a trench filled with gravel with a perforated pipe at the bottom. The pipe and gravel are wrapped in a protective “geotextile” fabric. Moisture accumulating in the trench percolates down and enters the pipe which transports the moisture to some point of discharge.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	EMS Station 33, 4514 James Wheat, Austin, TX
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Approximately \$75,000 in damages from three past flooding episodes.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Expansive Soils
<b>Effect on new/existing buildings:</b>	Modifications of the roofing and gutters to enhance drainage capabilities
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$130,000
<b>Potential Funding Sources:</b>	HMGP, General Fund
<b>Lead Agency/Department Responsible:</b>	COA Public Works, Building Services, EMS
<b>Implementation Schedule:</b>	1 year from initiation
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
During heavy rain events, the facility does not have adequate guttering to direct the water away from the facility. In addition, the landscaping does not allow for excessive runoff and rainfall to drain away from the facility. More water accumulates than can drain away, and subsequently backs up into the facility. This has occurred 3 times in the recent past, damaging floors, baseboards, walls, cabinets and furniture.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 3; Legal = 5; Economically Sound = 4; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>City of Austin – Action #17</b>	
<b>Proposed Action:</b>	<b>Develop new pavement design criteria that addresses expansive soils to minimize damage to roadway structures from changes in soil moisture. Implement new criteria to ensure construction of longer lasting roadways with less environmental damage, lower maintenance costs, fewer repairs required, and less frequent reconstruction.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Current cost is \$310,000 (HVJ Associates consultant contract value).  The losses avoided would be \$61.5 million. (20 yr. rules in use x (20 yr. / 65 yr.) lost life x 0.5 on expansive clay x 50 LM/yr. x \$400k/LM = \$61.5 Million additional reconstruction needed).
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Expansive Soils
<b>Effect on new/existing buildings:</b>	Cracking, distortion, roughness, structural damage
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$310,000
<b>Potential Funding Sources:</b>	City of Austin, Travis County, Williamson County, City of Pflugerville
<b>Lead Agency/Department Responsible:</b>	Austin/Travis Co/Williamson Co/Pflugerville
<b>Implementation Schedule:</b>	2012-2016
<b>Incorporation into Existing Plans:</b>	Transportation Criteria Manual

<b>COMMENTS:</b>
On-going engineering consultant study to develop new pavement design criteria. Criteria must be posted for adoption and approved by a rules posting process by each agency.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #18</b>	
<b>Proposed Action:</b>	Educate and train civil and geotechnical engineers on new pavement design criteria, specifications, and design strategies that address expansive soils to minimize damage to roadway structures from changes in soil moisture.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Current cost is \$11,520. (4 hrs. of training x 30 hrs. /hr. preparation for presentation x \$60/hr. = \$7,200 Train staff of 24 x 4 hrs. training x \$45/hr. = \$4,320 + \$7,200 = \$11,520).  Losses avoided would be \$30,750,000. (0.5 designed improperly x 20 yr. rules in use x (20 yr. / 65 yr.) lost life x 0.5 on expansive clay x 50 LM/yr. new subdivisions x \$400,000/LM = \$30,750,000 additional street reconstruction needed).
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Expansive Soils
<b>Effect on new/existing buildings:</b>	Cracking, distortion, roughness, structural damage
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$11,520
<b>Potential Funding Sources:</b>	City of Austin
<b>Lead Agency/Department Responsible:</b>	Public Works Department
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Capital Improvements Plan, Comprehensive Land Use Plan

<b>COMMENTS:</b>
On-going engineering consultant study to develop new pavement design criteria. Criteria must be posted for adoption and approved by a rules posting process by each agency.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 5; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #19</b>	
<b>Proposed Action:</b>	<b>Educate and train inspectors and contractors on the new specifications and pavement design criteria to ensure proper construction of roadways. New criteria will address expansive soils to minimize damage to roadway structures from changes in soil moisture. Partner with industry groups to develop and provide a formal certification program to document successful completion of this training.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Current cost is \$24,000. (4 hrs. of training x 20 hrs. of prep for presentation x \$60/hr. = \$4,800 and 4 Certification programs (Asphalt, Concrete, Stabilization, Soils) x 2 weeks x 40 hr. /wk. x \$60/hr. = \$19,200).  Losses avoided would be \$15,375,000. (0.25 constructed improperly x 20 yr. rules in use x (20 yr. / 65 yr.) lost life x 0.5 on expansive clay x 50 LM/yr. new subdivisions x \$400,000/LM = \$15,375,000 additional street reconstruction needed).
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness Programs

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Expansive Soils
<b>Effect on new/existing buildings:</b>	Cracking, distortion, roughness, structural damage
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$24,000
<b>Potential Funding Sources:</b>	City of Austin
<b>Lead Agency/Department Responsible:</b>	Public Works Department
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Capital Improvements Plan

<b>COMMENTS:</b>
On-going engineering consultant study to develop new pavement design criteria. Criteria must be posted for adoption and approved by a rules posting process by each agency.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 5; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

Section 24: Mitigation Actions

<b>City of Austin – Action #20</b>	
<b>Proposed Action:</b>	<b>Develop new criteria for designing structures and slabs on expansive soils to minimize damage to structures from changes in soil moisture. Implement new criteria to ensure construction of longer lasting structures with less environmental damage, lower maintenance costs, and fewer repairs required.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Current Cost: \$51,200. (SBO: 8 wks. x 40 hr. /wk. x \$60/hr. = \$19,200; QMD: 2 wks. x 40 hr. /wk. x \$200/hr. (3.4 O/H rate) = \$16,000; ESD: 2 wks. x 40 hr. /wk. x \$200/hr. (3.4 O/H rate) = \$16,000).  Losses Avoided: \$20,000,000. (10 yr. / 50 yr.) reduction in useful service life of structures x \$100,000,000 in City of Austin facilities built on expansive clays over next 20 years = \$20,000,000 serviceability loss (repairs/rehabilitation/replacement).
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Expansive Soils
<b>Effect on new/existing buildings:</b>	Cracking, distortion, roughness, structural damage
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$51,200
<b>Potential Funding Sources:</b>	City of Austin
<b>Lead Agency/Department Responsible:</b>	Public Works
<b>Implementation Schedule:</b>	2017-2018
<b>Incorporation into Existing Plans:</b>	Technical Criteria Manuals, Capital Improvements Plan, Comprehensive Land Use Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 3; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

Section 24: Mitigation Actions

<b>City of Austin – Action #21</b>	
<b>Proposed Action:</b>	<b>Implement an inspection program to inspect and evaluate scour potential for small bridge and culvert structures not inspected by the TxDOT BRINSAP (NBIS) program.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	<p>Current Costs: \$117,500. (~1,000 small structures (500 culverts and 500 pipes) 1000 x (1.5 hrs. field (tech) x \$35/hr. + 1 hr. office (tech) x \$35/hr. + 0.5 hr. office (engineer) x \$60/hr.) = \$117,500).</p> <p>Losses Avoided: \$3,000,000. (~500 culverts x 10% need scour mitigation = 50 culverts; Estimate: \$10,000 per location for scour mitigation; 50 culverts x \$10,000/culvert = \$500,000 (mitigation/repair); Permanent Mitigation/Repair = \$500,000; Damage for lack of mitigation 3 x \$500,000 = \$1,500,000; Temporary emergency repairs/TCP 1 x \$500,000 = \$500,000; Public Inconvenience &amp; Hazard 1 x \$500,000 = \$500,000).</p>
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood
<b>Effect on new/existing buildings:</b>	structural damage from debris and scouring
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$117,500
<b>Potential Funding Sources:</b>	City of Austin
<b>Lead Agency/Department Responsible:</b>	Public Works Department
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Bridge Management Information System

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 5; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

Section 24: Mitigation Actions

<b>City of Austin – Action #22</b>	
<b>Proposed Action:</b>	<b>Construct scour and erosion protection of bridges and culverts with high scour potential.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	<p>Current Cost: \$2,000,000. (465 bridges x 10%+ need scour mitigation = 50 bridges; \$300,000/yr. scour mitigation annually in bridge maintenance; contract for 10 major bridges = \$30,000 per location for scour mitigation (major); 50 bridges x \$30,000/bridge = \$1,500,000 (mitigation/repair); ~500 culverts x 10% need scour mitigation = 50 culverts; Estimate: \$10,000 per location for scour mitigation (minor); 50 culverts x \$10,000/culvert = \$500,000 (mitigation/repair)).</p> <p>Losses Avoided: \$12,000,000. (Permanent Mitigation/Repair = \$1,500,000; Damage from lack of mitigation 3 x \$1,500,000 = \$4,500,000; Temp. emergency repairs/TCP 1 x \$1,500,000 = \$1,500,000; Public Inconvenience &amp; Hazard 1 x \$1,500,000 = \$1,500,000; = \$9,000,000 bridges; Permanent Mitigation/Repair = \$500,000; Damage from lack of mitigation 3 x \$500,000 = \$1,500,000; Temp. emergency repairs/TCP 1 x \$500,000 = \$500,000; Public Inconvenience &amp; Hazard 1 x \$500,000 = \$500,000; = \$3,000,000 culverts).</p>
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

## Section 24: Mitigation Actions

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<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood
<b>Effect on new/existing buildings:</b>	Structural damage from scouring and loss of substructure or foundation support
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$2,000,000
<b>Potential Funding Sources:</b>	City of Austin
<b>Lead Agency/Department Responsible:</b>	Public Works Department
<b>Implementation Schedule:</b>	2016-2020
<b>Incorporation into Existing Plans:</b>	Bridge Maintenance Programs

<b>COMMENTS:</b>
<p><b>ADDITIONAL CONSIDERATIONS:</b>            The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)            Socially Acceptable = 5; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 5; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5</p>

## Section 24: Mitigation Actions

<b>City of Austin – Action #23</b>	
<b>Proposed Action:</b>	<b>Establish new rural roadway design criteria with wider paved shoulders where feasible for less potential of fire caused by vehicles or motorists and better performance of roadways on expansive soils. Additional edge protection creates longer distance to fuel sources for fire and longer moisture path to travel lanes for soil stability.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Current Cost: \$36,000. (SBO: 4 weeks x 40 hr./wk. x \$60/hr. = \$9,600; AFD: 4 weeks x 40 hr./wk. x \$60/hr. = \$9,600; ATD: 2 weeks x 40 hr./wk. x \$60/hr. = \$4,800; QMD: 1 weeks x 40 hr./wk. x \$200/hr. (3.4 O/H rate) = \$8,000; ESD: 0.5 weeks x 40 hr./wk. x \$200/hr. (3.4 O/H rate) = \$4,000).  Losses Avoided: no data. (There is limited data on the damages resulting from wildfires and few damaging wildfires have been identified, however the potential is generally accepted to be moderate to high).
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire, Expansive Soils
<b>Effect on new/existing buildings:</b>	Reduce number of urban wildfires and resulting damages
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$36,000
<b>Potential Funding Sources:</b>	City of Austin
<b>Lead Agency/Department Responsible:</b>	Public Works Department
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	Transportation Criteria Manual

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 5; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #24</b>	
<b>Proposed Action:</b>	<b>Initiate the adoption of the International Code Councils' Wildland Urban Interface Code or an equivalent regulatory framework, to mitigate the threat of wildfire in high risk areas of the city.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk to residents and first responders, minimizes financial loss to residents and property.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire
<b>Effect on new/existing buildings:</b>	Applies to new construction with the exception of major renovations
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Local Funds, Inspections, In-kind
<b>Lead Agency/Department Responsible:</b>	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development
<b>Implementation Schedule:</b>	2018
<b>Incorporation into Existing Plans:</b>	City of Austin Building Code, Community Wildfire Protection Plan, Subdivision Design Manual

<b>COMMENTS:</b>
The City of Austin has no existing regulatory mechanism to comprehensively address the threat of wildfire. Future development absent of consideration of wildfire will result in significant loss of property and potentially human life. The adoption of the Wildland Urban Interface Code would address future development in high risk areas to ensure the built environment is compatible with the local fire adapted ecosystems. According to the University of Baylor Risk report, 26% or 242,000 homes in Austin are currently at risk from wildfire. The Austin Travis County Community Wildfire Protection Plan, defined the Austin and Travis counties Wildland Urban Interface and recommends the adoption of the WUI Code.
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #25</b>	
<b>Proposed Action:</b>	<b>Develop evacuation plan for areas without adequate collector roadways and connectivity during a wildfire or other emergency events. Plan may include the mitigation of pinch points, and high ignition corridors traffic control strategies.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Benefits citizens and first responders' safety.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire
<b>Effect on new/existing buildings:</b>	Potential impact on road design to include width, and right of way maintenance
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$137,000
<b>Potential Funding Sources:</b>	Local Funds, Inspections, In-kind
<b>Lead Agency/Department Responsible:</b>	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development.
<b>Implementation Schedule:</b>	2018
<b>Incorporation into Existing Plans:</b>	City of Austin Building Code, Community Wildfire Protection Plan, Subdivision Design Manual

<b>COMMENTS:</b>
The City of Austin has no existing wildfire evacuation plan. The peak burning period for wildfires correlates with peak afternoon traffic congestion, resulting in numerous areas along major routes being gridlocked at a time when wildfire based evacuations are most likely. According to the University of Baylor Risk report, 26% or 242,000 homes in Austin are currently at risk from wildfire.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 5; Politically Acceptable = 4; Legal = 3; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>City of Austin – Action #26</b>	
<b>Proposed Action:</b>	<b>Utilization of goats to mitigate fire fuels in high risk areas where the use of mechanical equipment would result in environmental impacts. Establishment of contract services for grazing in designated high risk corridors.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduced risk of loss of life and property.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Natural System Protection

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire
<b>Effect on new/existing buildings:</b>	NA
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$117,000 annually
<b>Potential Funding Sources:</b>	Local Funds, Inspections, In-kind
<b>Lead Agency/Department Responsible:</b>	Lead: Austin Fire Department; Office of Sustainability, PARD, AWU
<b>Implementation Schedule:</b>	2017
<b>Incorporation into Existing Plans:</b>	Austin Community Wildfire Protection Plan, Austin Invasive Species Management Plan

<b>COMMENTS:</b>
The City of Austin has many high risk areas that, due to accessibility, traditional cost of treatment and environmental considerations cannot be mitigated with mechanical treatments. Well managed grazing animals provide a low impact high benefit fuels reduction alternative. The city currently manages 66,000 acres of open space much of which is prone to periodic wildfires. According to the University of Baylor Risk report, 26% or 242,000 homes in Austin are currently at risk from wildfire.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #27</b>	
<b>Proposed Action:</b>	Replacement of wooden attachments to structures and installation of ember resistive ventilations systems. This project would include the replacement of existing combustible decks and fences with ignition resistant materials as well as retrofit of ventilation systems to include ember resistive components.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduced risk of loss of life and property.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structural and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire
<b>Effect on new/existing buildings:</b>	Retrofit of existing structure attachments and ventilation systems
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$30,000,000
<b>Potential Funding Sources:</b>	Local Funds, Inspections, In-kind
<b>Lead Agency/Department Responsible:</b>	Lead: Austin Fire Department; Travis County TNR and OEM, Office of Sustainability, PDR
<b>Implementation Schedule:</b>	2018
<b>Incorporation into Existing Plans:</b>	Austin Community Wildfire Protection Plan, Austin Fire Code

<b>COMMENTS:</b>
There are over 15,000 homes located in at risk areas across Austin and Travis County that have highly combustible wood decking and fences. In addition ventilation systems in these areas are vulnerable to ember intrusion. According to the University of Baylor Risk report, 26% or 242,000 homes in Austin are currently at risk from wildfire.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 3; Administratively Possible = 5; Politically Acceptable = 4; Legal = 3; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>City of Austin – Action #28</b>	
<b>Proposed Action:</b>	<b>Establish an alternate power supply at Austin Police Department station so law enforcement can continue to operate in an emergency that effects the city’s power grid.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin Police Department - 715 E 8 <sup>th</sup> St, Austin, TX 78791
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Continue essential services to residents.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire, Tornado, Winter Storm, Extreme Heat, Hurricane Wind, Thunderstorm Wind, Dam Failure, Hail, Flood, Cyber, Technological Disruption, Terrorism
<b>Effect on new/existing buildings:</b>	Continue to provide essential services
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	HMGP, other grants
<b>Lead Agency/Department Responsible:</b>	Austin Police Department
<b>Implementation Schedule:</b>	2017
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
During recent flooding, parts of downtown Austin lost power. This caused the APD generator to activate. The gap or interim between the COA power and generator power caused the computer system to reboot, and Department Operations Center and the Real Time Crime Center lost internet and phones, thus losing the ability to command the flood response. Element D1 of Plan Review, Evaluation and Implementation is addressed in this issue. The COA switched, since the 2010 Hazard Mitigation Plan, to VOIP lines. The old “copper” phone lines had internal power, and loss of COA power would not affect the usage of the phones.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #29</b>	
<b>Proposed Action:</b>	<b>Establish an alternate power supply at the City of Austin Public Safety Training Center (PSTC) so emergency services can continue to operate in an emergency that affects the city’s power grid. This will include a generator and an Uninterrupted Power Supply (UPS).</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Public Safety Training Center - 4800 Shaw Ln, Austin, TX 78744
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Continue essential services to residents.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire, Tornado, Winter Storm, Extreme Heat, Hurricane Wind, Thunderstorm Wind, Dam Failure, Hail, Cyber, Technological Disruption, Terrorism
<b>Effect on new/existing buildings:</b>	Continue to provide essential services
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	HMGP, other grants
<b>Lead Agency/Department Responsible:</b>	Austin Police Department
<b>Implementation Schedule:</b>	2017
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
During recent flooding several emergency generators in COA buildings were activated. The gap or interim between the COA power and generator power caused computer systems to reboot. This reboot included the telephone system, resulting in the loss of communication between and within agencies. THE PSTC has been selected as a COOP site for several emergency services, but the site does not have a generator or UPS. Element D1 of Plan Review, Evaluation and Implementation is addressed in this issue. The COA switched, since the 2010 Hazard Mitigation Plan, to VOIP lines. The old “copper” phone lines had internal power, and loss of COA power would not previously affect the usage of the phones.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #30</b>	
<b>Proposed Action:</b>	<b>Develop a safe room program to retrofit residences in order to protect against a tornado or hurricane wind event.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	To be determined
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk of loss of life.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Tornado, Hurricane Wind
<b>Effect on new/existing buildings:</b>	This action would strengthen existing buildings and residences by making them more resistant to damage from tornadoes and hurricane winds
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$6,000 per safe room
<b>Potential Funding Sources:</b>	Federal Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Implementation Schedule:</b>	To be implemented after receipt of funds
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #31</b>	
<b>Proposed Action:</b>	<b>Conduct public awareness campaign for realtors, insurance agents, lenders, surveyors and other professionals on benefits of flood insurance under the National Flood Insurance Program (NFIP).</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. The NFIP benefits those who have purchased flood insurance for their homes. More training is needed regarding policies for agents, lenders and other professionals.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Thunderstorm Wind
<b>Effect on new/existing buildings:</b>	This action would reduce the impact of flooding for existing and new structures
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Staff time
<b>Potential Funding Sources:</b>	General Revenue
<b>Lead Agency/Department Responsible:</b>	Partner with other associations and groups currently providing NFIP training
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #32</b>	
<b>Proposed Action:</b>	<b>Increase public awareness regarding the National Flood Insurance Program (NFIP) and Preferred Risk Policy by holding educational forums for residents outside of the Special Flood Hazard Area (SFHA).</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Austin experiences flooding and flash flooding which leads to damage to property and even fatalities. Flood insurance provides protection to those who have purchased flood insurance for their homes. Over 30% of NFIP claims occur outside of the SFHA.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Thunderstorm Wind
<b>Effect on new/existing buildings:</b>	This action would result in stronger buildings if citizens purchased flood insurance
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$5,000 per year
<b>Potential Funding Sources:</b>	Grants and general revenue
<b>Lead Agency/Department Responsible:</b>	HSEM – partnering with organizations providing free NFIP training where available.
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #33</b>	
<b>Proposed Action:</b>	Install perimeter lighting at Tom Miller, Decker and Longhorn Dams. Perimeter lighting will ensure visibility so that proper action can be taken, including alerting the community, especial if there is a dam failure or potential breach.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Tom Miler Dam – 20.294°N, 97.786°W; Decker Dam – 30.285°N, 97.597°W; Longhorn Dam – 30.250° N, 97.714°W
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	The city has not experienced a major dam failure since the early 1930s. Perimeter lighting would help increase security at the above locations.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Dam Failure, Terrorism
<b>Effect on new/existing buildings:</b>	Prevent flood damage to existing structures within the inundation area for each dam
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #34</b>	
<b>Proposed Action:</b>	<b>Strengthen access restrictions at Tom Miller, Decker and Longhorn Dams.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Tom Miler Dam – 20.294°N, 97.786°W; Decker Dam – 30.285°N, 97.597°W; Longhorn Dam – 30.250° N, 97.714°W
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Although the last major dam failure occurrence for the City was the result of a flood in the 1930s, access restrictions are necessary in light of concerns for terrorism since 9/11.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Terrorism
<b>Effect on new/existing buildings:</b>	Prevent flood damage to existing structures within the inundation area for each dam
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #35</b>	
<b>Proposed Action:</b>	<b>Purchase communication equipment for uniform communication capability among first responders in the event of a pipeline failure or hazardous material spill.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	The city does not have radio equipment that would be safe to use to communicate nearby a hazardous material release or pipeline failure. Technology is currently available for radios that would allow for communication even in a volatile environment.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Pipeline Failure, Hazardous Material Release, Terrorism
<b>Effect on new/existing buildings:</b>	This action enhances communicability between responders and does not directly impact new/existing buildings
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Implementation Schedule:</b>	2016-2017 with replacements as needed
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #36</b>	
<b>Proposed Action:</b>	Increase public awareness of the dangers of pipeline failure through the Pipeline Safety Trust, a NFP Public charity in order to promote fuel transportation safety.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk of loss of life and property.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Pipeline Failure, Terrorism
<b>Effect on new/existing buildings:</b>	This action does not directly affect new/existing buildings
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Staff time
<b>Potential Funding Sources:</b>	Grants
<b>Lead Agency/Department Responsible:</b>	HSEM
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #37</b>	
<b>Proposed Action:</b>	<b>Create a neighborhood and community plan, including drills and exercises to educate the public regarding the location of pipelines and actions to take in the event of a hazardous material spill.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	The city has experienced few man-caused events, but citizens should be aware of procedures and locations of hazardous areas.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Pipeline Failure, Hazardous Material Release
<b>Effect on new/existing buildings:</b>	This action primarily concerns protecting lives instead of directly effecting buildings
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Minimal cost as partnering opportunities are available
<b>Potential Funding Sources:</b>	General Revenue and grants where available
<b>Lead Agency/Department Responsible:</b>	Austin Fire Department; Watershed Protection and Development Services
<b>Implementation Schedule:</b>	2016
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #38</b>	
<b>Proposed Action:</b>	<b>Create and implement an Extreme Event Recovery Plan that includes a Social Capital component. The plan would be based on expert knowledge in this area and would shares best practices with a variety of urban change makers.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Post disaster relief to reduce long-term stressors for vulnerable communities.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber, Technological Disruption
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$100,000
<b>Potential Funding Sources:</b>	HUD
<b>Lead Agency/Department Responsible:</b>	ATCHHSD
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	CHA/CHIP

<b>COMMENTS:</b>
Social Capital: For an individual, social capital is about relationships with family, friends, and colleagues. In communities, social capital can be measured by levels of trust, the cohesion of social networks, and the quality of leadership. Cities that are resilience to extreme weather events build social capital with neighborhoods and public spaces that encourage interaction and through participatory, inclusive governance. Yet, while there is growing appreciation of its importance, too little is known about how to measure, cultivate, and maintain social capital.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #39</b>	
<b>Proposed Action:</b>	<b>As the next step of the CHA/CHIP, Austin/Travis County Health and Human Services Department will initiate Building Resilience Against Climate Effects (BRACE), a CDC developed framework that allows public health departments put complex atmospheric science and climate projections into their mitigation, planning and response activities.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Austin, Texas; Travis County, Texas
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Health effects related to climate
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Infectious Diseases, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber, Technological Disruption
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$100,000
<b>Potential Funding Sources:</b>	CDC
<b>Lead Agency/Department Responsible:</b>	ATCHHSD
<b>Implementation Schedule:</b>	2016-2017
<b>Incorporation into Existing Plans:</b>	CHA/CHIP

<b>COMMENTS:</b>
BRACE: In 2014, the third National Climate Assessment clearly described climate change as a threat to human health and well-being. Climate change is predicted to result in more extreme heat events, more frequent and violent weather disasters, decreased air quality and more insect-related disease. And, the Assessment states that some of the health impacts of climate change are already happening in the United States. Health effects related to climate will worsen existing health problems as well as introduce new and serious risks to the public's health.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 5; Legal = 4; Economically Sound = 3; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>City of Austin – Action #40</b>	
<b>Proposed Action:</b>	<b>Conduct public education to promote Xeriscaping of vegetation that requires little water for times of drought when water resources are low.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	Citywide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk of wildfire, fire fuels, loss of life and property, conservation of water.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Drought
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$25,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	Lead: Austin Fire Department; Planning and Development, Office of Sustainability, Travis County Planning and Development.
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

### AISD

<b>Austin Independent School District – Action #1</b>	
<b>Proposed Action:</b>	<b>Elevate electrical transformers at AISD’s House Park, located at Shoal Creek Blvd, Austin, TX 78701.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	AISD’s House Park
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Protection of property; reduce risk to public health, safety, and welfare.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Dam Failure
<b>Effect on new/existing buildings:</b>	Protects electrical infrastructure for existing facility
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	Moderate
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
AISD’s House Park was severely impacted by flooding that took place on Memorial Day 2015, highlighting the need to mitigate against future damage to electrical equipment there.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #2</b>	
<b>Proposed Action:</b>	<b>Design and construct floodwalls around flood-prone AISD properties such as House Park.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	AISD's House Park and other flood-prone properties
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk to properties throughout school district from flood; reduce risk to students and faculty from flood.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Flood, Dam Failure
<b>Effect on new/existing buildings:</b>	Reduces breach of floodwaters in existing facility
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$325,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
AISD's House Park was severely impacted by flooding that took place on Memorial Day 2015, highlighting the need to erect floodwalls to redirect floodwater to nearby creeks. This project is thought to cause minimal adverse impact to nearby businesses and structures.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #3</b>	
<b>Proposed Action:</b>	<b>Develop and implement water monitoring system to detect leaks and monitor local water supplies to conserve water for drought seasons.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce use of water during the event of a drought.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Natural Systems Protection

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Drought
<b>Effect on new/existing buildings:</b>	Reduces water footprint of AISD
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$1,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management/Service Center
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #4</b>	
<b>Proposed Action:</b>	Install a network of dry hydrants in stock ponds, creeks, water reservoirs, small lakes, and retention areas to increase and preserve water supply.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce use of water during the event of a drought.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Natural Systems Protection

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Drought
<b>Effect on new/existing buildings:</b>	Provides water for fire protection of structures
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$500,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management/Service Center
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

Austin Independent School District – Action #5	
<b>Proposed Action:</b>	Develop a MOU and coordinate with the City of Austin to develop and implement a drought contingency plan to provide for sanitation and fire protection, protect and preserve the public health, and mitigate the impacts of water supply shortage during a period of drought.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Ensure health and safety of residents is protected during a drought.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Local Plans and Regulations

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Drought
<b>Effect on new/existing buildings:</b>	Reduces water footprint of AISD
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$50,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #6</b>	
<b>Proposed Action:</b>	<b>Develop and build a new AISD facility that functions as community-wide FEMA approved disaster Safe Room.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce potential loss to students, faculty, and residents in proximity of safe room during disasters.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Hurricane Wind, Thunderstorm Wind, Tornado
<b>Effect on new/existing buildings:</b>	Moderate effect on newly-built structure
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$3,500,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

Austin Independent School District – Action #7	
<b>Proposed Action:</b>	<b>Conduct public education to promote FIREWISE practices such as removing debris, and constructing fire-resistant structures.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk of wildfire, fire fuels, loss of life and property.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Wildfire
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$250,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #8</b>	
<b>Proposed Action:</b>	<b>Conduct public education to promote Xeriscaping of vegetation that requires little water for times of drought when water resources are low.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce risk of wildfire, fire fuels, loss of life and property.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Wildfire
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$250,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #9</b>	
<b>Proposed Action:</b>	<b>Develop and implement extreme heat awareness campaign on mitigation techniques.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce effects on residents from extreme heat.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Extreme Heat
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$250,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

Austin Independent School District – Action #10	
<b>Proposed Action:</b>	<b>Retrofit existing AISD facilities with green roofs to reduce heat signature.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce effects on facilities from extreme heat.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Extreme Heat
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	Low
<b>Estimated Cost:</b>	\$10,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #11	
<b>Proposed Action:</b>	<b>Purchase mobile back-up generators for critical nodes around AISD, such as the Service Center and the Skyline Building, both of which house network servers.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Ensure continuation of essential services to the school district in the event of a disaster.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Thunderstorm Wind, Flood, Wildfire, Extreme Heat, Hail, Tornado, Winter Storm, Hurricane Wind, Dam Failure
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$5,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Facilities, Service Center
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

Section 24: Mitigation Actions

Austin Independent School District – Action #12	
<b>Proposed Action:</b>	Retrofit AISD facilities to mitigate impact damage from hail, such as placing protective covers over existing windows and hail guards on AC units.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit:</b> <i>(Current Cost/Losses Avoided)</i>	Reduce repairs and costs to facilities following a disaster event.
<b>Type of Action:</b> <i>(Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness)</i>	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Hail
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$1,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Facilities, Service Center
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #13	
<b>Proposed Action:</b>	<b>Retrofit AISD facilities as a hardened shelter that will be upgraded for safe shelter use in hazardous weather events or man-caused hazards.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Reduce potential loss to students and faculty during disasters.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Tornado, Thunderstorm Wind, Hurricane Wind, Hail, Flood, Dam Failure, Winter Storm, Wildfire, Infectious Diseases, Pipeline Failure, Terrorism, Hazardous Materials
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	Low
<b>Estimated Cost:</b>	\$5,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Facilities, Service Center
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #14</b>	
<b>Proposed Action:</b>	Use GIS technology to map AISD facilities that are susceptible to expansive soils and implement a program with new criteria for designing structures and slabs on expansive soils to use proven engineering solutions to minimize damage to structures from changes in soil moisture.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit (Current Cost/Losses Avoided):</b>	Reduce effects of soil expansion on properties.
<b>Type of Action: (Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness):</b>	Natural Systems Protection

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Expansive Soils
<b>Effect on new/existing buildings:</b>	Moderate impact on existing structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$40,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #15</b>	
<b>Proposed Action:</b>	<b>Retrofit critical AISD facilities with roadway heating system to offset impacts of ice accumulation.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit (Current Cost/Losses Avoided):</b>	Reduce risk to students and faculty of being trapped due to ice accumulation and being able to access critical AISD facilities in the event of a winter storm.
<b>Type of Action: (Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness):</b>	Structure and Infrastructure Project

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Winter Storm
<b>Effect on new/existing buildings:</b>	Moderate impact on existing structures
<b>Priority (High, Moderate, Low):</b>	Moderate
<b>Estimated Cost:</b>	\$1,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

Austin Independent School District – Action #16	
<b>Proposed Action:</b>	<b>Retrofit AISD’s network servers with enhanced Intrusion Detection Systems (IDS) and Intrusion Prevention Systems (IPS).</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Reduce risk to network servers in the event of a cyber-attack.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Cyber
<b>Effect on new/existing buildings:</b>	High impact on existing structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$1,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Technology
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #17	
<b>Proposed Action:</b>	<b>Retrofit AISD’s networks with Barracuda servers/firewalls to prevent network intrusion and increase reliability.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Reduce risk of networks in the event of an intrusion or cyber-attack.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Cyber
<b>Effect on new/existing buildings:</b>	High impact on existing structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$1,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Technology
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

Austin Independent School District – Action #18	
<b>Proposed Action:</b>	Implement filtration and air-cleaning programs and systems to protect buildings and occupants from infectious diseases, biological, and radiological attacks.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Reduce the risk to students and faculty in the event of an infectious disease.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Infectious Diseases
<b>Effect on new/existing buildings:</b>	High impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$10,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Technology
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #19	
<b>Proposed Action:</b>	<b>Develop and build central mailing facility to prevent spread of infectious diseases and mitigate biological attacks.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Reduce risk to students and faculty of spreading infectious diseases.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Structure and Infrastructure Project

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Infectious Diseases
<b>Effect on new/existing buildings:</b>	High impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$4,000,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management, Purchasing
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

Austin Independent School District – Action #20	
<b>Proposed Action:</b>	<b>Practice FIREWISE mitigation techniques such as creating defensible space around structures.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Reduce risk to properties throughout school district and reduce risk to residents through education and awareness.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Local Plans and Regulations

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Wildfire
<b>Effect on new/existing buildings:</b>	Extensive impact on existing and new structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #21	
<b>Proposed Action:</b>	<b>Develop evacuation plan and routinely conduct evacuation exercises.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit (Current Cost/Losses Avoided):</b>	Increased awareness of evacuation procedures; reduce and prevent loss of life and injury.
<b>Type of Action: (Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness):</b>	Education and Awareness

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Flood, Tornado, Hurricane Wind, Thunderstorm Wind, Wildfire, Winter Storm
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$25,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

Austin Independent School District – Action #22	
<b>Proposed Action:</b>	Educate the public on mitigation activities that can help protect properties in the event of a flood, such as elevate AC units, elevate structures, and use of freeboard.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Protection of properties; reduce risk to public health, safety and welfare.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Education and Awareness

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Flood, Dam Failure
<b>Effect on new/existing buildings:</b>	Protection of property and potential new infrastructure
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$50,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #23	
<b>Proposed Action:</b>	<b>Purchase NOAA “All Hazards” radios for early warning and event information to be placed throughout school district.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit (Current Cost/Losses Avoided):</b>	Increase warning time in the event of a disaster.
<b>Type of Action: (Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness):</b>	Education and Awareness

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber, Technological Disruption
<b>Effect on new/existing buildings:</b>	Increase time to retrofit and protect structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$150
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 5; Technically Feasible = 4; Administratively Possible = 5; Politically Acceptable = 4; Legal = 5; Economically Sound = 4; and Environmentally Sound = 5

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #24</b>	
<b>Proposed Action:</b>	<b>Conduct outreach to increase public awareness by teaching students about the dangers of hail and how to take safety precautions.</b>
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit (Current Cost/Losses Avoided):</b>	Promote safety and increase safety to students.
<b>Type of Action: (Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness):</b>	Education and Awareness

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Hail
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$5,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

<b>COMMENTS:</b>
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #25	
<b>Proposed Action:</b>	Implement a public education program to increase public awareness by teaching students and faculty about the dangers of hazards and what precautions to take during a disaster or natural hazard.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	Promote safety and increase safety to students.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Education and Awareness

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Flood, Extreme Heat, Drought, Hail, Winter Storm, Hurricane Wind, Thunderstorm Wind, Tornado, Wildfire, Hazardous Materials, Pipeline Failure, Terrorism, Expansive Soils, Cyber, Technological Disruption
<b>Effect on new/existing buildings:</b>	N/A
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$1,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Police Department, Risk Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Emergency Ops Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

Austin Independent School District – Action #26	
<b>Proposed Action:</b>	Retrofit AISD existing facilities with wind resistant and shatter proof windows, mitigation includes replacing seals, installing A/C covers and tie-downs, and hardening roofs.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	AISD locations and critical facilities
<b>Risk Reduction Benefit</b> ( <i>Current Cost/Losses Avoided</i> ):	AISD area schools housed evacuees from Hurricane Ike and also were minimally damaged from hurricane winds. Stronger windows are needed to resist hurricane winds and also damage from hail, ice or flooding during a hazard event.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Structure and Infrastructure Projects

MITIGATION ACTION DETAILS	
<b>Hazard(s) Addressed:</b>	Hurricane Wind, Tornado, Winter Storm, Hail, Thunderstorm Wind, Flood
<b>Effect on new/existing buildings:</b>	This action would strengthen current buildings by making them more resistant to hurricane and high winds
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	TBD
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Office of Homeland Security and Emergency Management
<b>Implementation Schedule:</b>	By 2020
<b>Incorporation into Existing Plans:</b>	Emergency Operations Plan

COMMENTS:
<b>ADDITIONAL CONSIDERATIONS:</b>
The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies)
Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

## Section 24: Mitigation Actions

<b>Austin Independent School District – Action #27</b>	
<b>Proposed Action:</b>	Modify the existing structures and make improvements to allow proper draining of excess rainwater away from the facility, such as installing a French Drain, which is basically a trench filled with gravel with a perforated pipe at the bottom. Moisture accumulating in the trench percolates down and enters the pipe which transports the moisture to some point of discharge.
<b>BACKGROUND INFORMATION</b>	
<b>Site and Location:</b>	District-wide
<b>Risk Reduction Benefit (Current Cost/Losses Avoided):</b>	Reduce effects swelling and shrinking soils on properties.
<b>Type of Action:</b> ( <i>Local Plans and Regulations, Structure and Infrastructure Projects, Natural Systems Protection, or Education and Awareness</i> ):	Natural Systems Protection

<b>MITIGATION ACTION DETAILS</b>	
<b>Hazard(s) Addressed:</b>	Expansive Soils
<b>Effect on new/existing buildings:</b>	Moderate impact on existing structures
<b>Priority (High, Moderate, Low):</b>	High
<b>Estimated Cost:</b>	\$250,000
<b>Potential Funding Sources:</b>	DHS, FEMA
<b>Lead Agency/Department Responsible:</b>	AISD – Construction Management
<b>Implementation Schedule:</b>	By 2018
<b>Incorporation into Existing Plans:</b>	Facility Master Plan, Emergency Ops Plan

<b>COMMENTS:</b>
A more expensive option would be to build a perimeter apron. The perimeter apron is a broad protective pavement which is applied to the surface grade around the entire perimeter of the building. All plants and planters are removed. All roof and surface drainage is controlled and directed away from the building.
<b>ADDITIONAL CONSIDERATIONS:</b> The following STAPLEE criteria were evaluated on a scale of 1 to 5 indicating the extent to which this action satisfies each consideration. (1= Does Not Satisfy 3 = Moderately Satisfies 5 = Strongly Satisfies) Socially Acceptable = 4; Technically Feasible = 5; Administratively Possible = 4; Politically Acceptable = 5; Legal = 4; Economically Sound = 5; and Environmentally Sound = 4

# Section 25: Plan Maintenance

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## Plan Maintenance Procedures

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The following is an explanation of how the City of Austin, AISD, and the general public will be involved in implementing, evaluating, and enhancing the Plan over time. The sustained hazard mitigation planning process consists of four main parts:

- Incorporation
- Monitoring and Evaluation
- Updating
- Continued Public Involvement

## Incorporation

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The City of Austin and the AISD will be responsible for further development and implementation of mitigation actions. Each action has been assigned to a specific department within the City and AISD. The following describes the process by which Austin will incorporate elements of the mitigation plan into other planning mechanisms.

### Process of Incorporation

Once the Plan is adopted, the City and AISD will implement actions based on priority and the availability of funding. The City currently implements policies and programs to reduce loss to life and property from hazards. The mitigation actions developed for this Plan enhance this ongoing effort and will be implemented through other program mechanisms where possible.

The potential funding sources listed for each identified action may be used when the jurisdiction seeks funds to implement actions. An implementation time period or a specific implementation date has been assigned to each action as an incentive for completing each task and gauging whether actions are implemented in a timely manner.

The City of Austin and AISD will integrate implementation of their mitigation actions with other plans and policies such as construction standards and emergency management plans, and ensure that

## Section 25: Plan Maintenance

these actions, or proposed projects, are reflected in other planning efforts. Coordinating and integrating components of other plans and policies into goals and objectives of the Plan will further maximize funding and provide possible cost-sharing of key projects, thereby reducing loss of lives and property, and mitigating hazards affecting the area.

Upon formal adoption of the Plan, planning team members from each participating jurisdiction will work to integrate the hazard mitigation strategies into other plans and codes, as they are developed. Participating team members will conduct periodic review of plans and policies, once per year at a minimum, and analyze the need for amendments in light of the approved Plan. The planning team will review all comprehensive land use plans, capital improvement plans, annual budget reviews, emergency operations or management plans, transportation plans, and any building codes to guide and control development. Participating jurisdictions will ensure that capital improvement planning in the future will also contribute to the goals of this hazard mitigation Plan to reduce the long-term risk to life and property from all hazards. Within one year of formal adoption of the hazard mitigation Plan, existing planning mechanisms will be reviewed by each jurisdiction.

The City of Austin is committed to supporting the cities, communities, and AISD as they implement their mitigation actions. The City of Austin and participating planning team members will review and revise, as necessary, the long-range goals and objectives in strategic plan and budgets to ensure that they are consistent with this mitigation action plan. Additionally, the City will work with AISD to advance the goals of this hazard mitigation plan through its routine, ongoing, long-range planning, budgeting, and work processes.

**Table 25.1 – Methods of Incorporation of the Plan**

Planning Mechanism	Department/Title Responsible	Incorporation of Plan
Grant Applications	City of Austin: Office of Homeland Security & Emergency Management / Administrative Manager, Administration & Finance Programs  AISD: Emergency Management Coordinator	The Plan will be evaluated by the City of Austin and AISD when grant funding is sought for mitigation projects. If a project is not in the Plan, an amendment may be necessary to include the action in the Plan.
Annual Budget Review	City of Austin: Office of Homeland Security & Emergency Management / HSEM Accountant  AISD: Emergency Management Coordinator	Various departments and key personnel that participated in the planning process for the City of Austin and AISD will review the Plan and mitigation actions therein when conducting their annual budget review. Allowances will be made in accordance with grant applications sought, and mitigation actions that will be undertaken, according to the implementation schedule of the specific action.

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Planning Mechanism	Department/Title Responsible	Incorporation of Plan
Regulatory Plans	<p>City of Austin: Office of Homeland Security &amp; Emergency Management / Senior Emergency Plans Officer</p> <p>AISD: Emergency Management Coordinator</p>	<p>Currently, the City of Austin and AISD have regulatory plans in place, such as Emergency Management Plans, Continuity of Operations Plans, Disaster Recovery Plans, and Economic Development and Evacuation Plans. The Plan will be consulted when City departments and the school board review or revise their current regulatory planning mechanisms, or in the development of regulatory plans that are not currently in place.</p>
Capital Improvement Plans	<p>City of Austin: Office of Homeland Security &amp; Emergency Management / Administrative Manager, Administration &amp; Finance Programs</p> <p>AISD: Emergency Management Coordinator</p>	<p>The City of Austin and AISD have a Capital Improvement Plan (CIP) in place. Prior to any revisions to the CIP, City departments and the school board will review the risk assessment and mitigation strategy sections of the HMAP, as limiting public spending in hazardous zones is one of the most effective long-term mitigation actions available to local governments.</p>
Comprehensive Plans	<p>City of Austin: Office of Homeland Security &amp; Emergency Management / Administrative Manager, Administration &amp; Finance Programs</p> <p>AISD: Emergency Management Coordinator</p>	<p>The City of Austin and AISD have a Comprehensive Plan in place. Since comprehensive plans involve developing a unified vision for a community, the mitigation vision and goals of the Plan will be reviewed in the development or revision of a Comprehensive Plan.</p>
Floodplain Management Plans/CRS	<p>City of Austin: Office of Homeland Security &amp; Emergency Management / Senior Emergency Plans Officer</p>	<p>Floodplain management plans include preventative and corrective actions to address the flood hazard. Therefore, the actions for flooding, and information found in Section 5 of this Plan discussing the people and property at risk to flood, will be reviewed and revised when Austin updates their management plans or develops new plans. The City also plans to pursue joining the Community Rating System (CRS) and addresses this as a mitigation action item.</p>

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Planning Mechanism	Department/Title Responsible	Incorporation of Plan
Emergency Operations Heat Plan	City of Austin: Office of Homeland Security & Emergency Management / Senior Emergency Plans Officer	The City of Austin created an Emergency Operations Heat Plan in 2011. The Heat Plan includes stages to address the extreme heat hazard. Phase 1, the Austin/Travis County Health and Human Services Department monitors emergency visits and calls regarding heat-related illnesses, but few actions are required. In Phase II, Austin's Heat Plan calls for opening "cooling centers," air-conditioned buildings such as libraries and churches that can be used as places from which to hand out water. The actions for extreme heat, and information found in Section 8 of this Plan discussing the people and property at risk to extreme heat. The Plan will be reviewed when Austin updates their management plans or develops new plans.

## Monitoring and Evaluation

Periodic revisions of the Plan are required to ensure that goals, objectives, and mitigation actions are kept current. Revisions may be required to ensure the Plan is in compliance with federal and state statutes and regulations. This section outlines the procedures for completing Plan revisions, updates, and review. Table 24-2 indicates the department and title of the party responsible for Plan monitoring, updating, and review of the Plan.

**Table 25-2. Team Members Responsible for Plan Monitoring, Updating and Review of the Plan**

JURISDICTION	DEPARTMENT	TITLE
City of Austin	Office of Homeland Security & Emergency Management	Director
City of Austin	Office of Homeland Security & Emergency Management	Senior Emergency Plans Officer
AISD	Austin ISD Police Department	Emergency Management Coordinator

### Monitoring

Designated Planning Team members are responsible for monitoring, updating, and reviewing the Plan, as shown in Table 25-2. Individuals holding the title listed in Table 25-2 will be responsible for monitoring the Plan on an annual basis. Plan monitoring, includes reviewing and incorporation into

## Section 25: Plan Maintenance

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the Plan other existing planning mechanisms that relate or support goals and objectives of the Plan; monitoring the incorporation of the Plan into future updates of other existing planning mechanisms as appropriate; reviewing mitigation actions submitted and coordinating with various City departments to determine if mitigation actions need to be re-evaluated and updated; evaluating and updating the Plan as necessary; and monitoring plan maintenance to ensure that the process described is being followed, on an annual basis, throughout the planning process. The Planning Team will develop a brief report that identifies if changes to the Plan are needed, such as recommending an action for funding. A summary of meeting notes will report the particulars involved in developing an action into a project.

### Evaluation

As part of the evaluation process, the Planning Team will assess changes in risk; determine whether the implementation of mitigation actions is on schedule; determine whether there are any implementation problems, such as technical, political, legal, or coordination issues; and identify changes in land development or programs that affect mitigation priorities for each respective department or organization.

The Planning Team will meet on an annual basis to evaluate the Plan and identify any needed changes. The annual evaluation process will help to determine if any changes are necessary.

## Updating

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### Plan Amendments

At any time, minor technical changes may be made to update the City of Austin Hazard Mitigation Plan. Material changes to mitigation actions or major changes in the overall direction of the Plan or the policies contained within it, must be subject to formal adoption by the City.

The City will review proposed amendments and vote to accept, reject, or amend the proposed change. Upon ratification, the amendment will be transmitted to TDEM.

In determining whether to recommend approval or denial of a Plan amendment request, the City will consider the following factors:

- Errors or omissions made in the identification of issues or needs during the preparation of the Plan;
- New issues or needs that were not adequately addressed in the Plan; and
- Changes in information, data, or assumptions from those on which the Plan was based.

### Five (5) Year Review

The Plan will be thoroughly reviewed by the Planning Team at the end of three years from the approval date, to determine whether there have been significant changes in the planning area that necessitate changes in the types of mitigation actions proposed. Factors that may affect the content of the Plan include new development in identified hazard areas, increased exposure to hazards, disaster declarations, increase or decrease in capability to address hazards, and changes to federal or state legislation.

The Plan review process provides the City and AISD an opportunity to evaluate mitigation actions that have been successful, identify losses avoided due to the implementation of specific mitigation

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measures, and address mitigation actions that may not have been successfully implemented as assigned.

It is recommended that the full Advisory Planning Team (Section 2, Table 2-1) meet to review the Plan at the end of three years because grant funds may be necessary for the development of a five-year update. Reviewing planning grant options in advance of the five-year Plan update deadline is recommended considering the timelines for grant and planning cycles can be in excess of a year.

Following the Plan review, any revisions deemed necessary will be summarized and implemented according to the reporting procedures and Plan amendment process outlined herein. Upon completion of the review, update, and amendment process the revised Plan will be submitted to TDEM for final review and approval in coordination with FEMA.

### Continued Public Involvement

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Public input was an integral part of the preparation of this Plan and will continue to be essential for Plan updates. Changes or suggestions to improve or update the Plan will provide opportunities for additional public input.

The public can review the Plan on the City of Austin HSEM website and copies of the Plan will be kept in the offices of the City and ISD (<http://www.austintexas.gov/department/hsem-media>), where officials and the public are invited to provide ongoing feedback by sending comments to a HSEM email. The City of Austin will also provide an opportunity for feedback during the annual Emergency Operations Plan review, which will also include the Hazard Mitigation Plan implementation, monitoring, and evaluation process on the agenda and attendees will have an opportunity to ask questions in the meeting. The public can also address questions through a HSEM email and social media. The annual meeting will be announced on the public docket, the public will be invited to attend, and will be broadcasted live on the Austin Channel, ATXN.

The Planning Team may also designate voluntary citizens from the City, or willing stakeholder members from the private sector businesses that were involved in the Plan's development to provide feedback on an annual basis. It is important that stakeholders and the immediate community maintain a vested interest in preserving the functionality of the planning area as it pertains to the overall goals of the mitigation plan. The Executive Planning team is responsible for notifying stakeholders and community members on an annual basis, and maintaining the Plan as a part of their job description.

Media, including local newspaper and radio stations, will be used to notify the public of any maintenance or periodic review activities. Additionally, Local News will broadcast regular updates regarding any changes or updates to the Plan, through their community public video segments. This media outlet, along with social media outlets such as Facebook and Twitter, will keep the public and stakeholders apprised of mitigation projects for which HMGP or PDM funding is made available for implementation of mitigation projects identified in the Plan.

# Appendix A: Planning Team

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Stakeholders .....	2

## Planning Team Members

The City of Austin Hazard Mitigation Plan Update 2016 (Plan or Plan Update), was organized using a direct representative model. An Executive Planning Team from the City of Austin Office of Homeland Security and Emergency Management, shown in Table A-1, was formed to coordinate planning efforts, and request input and participation in the planning process. Table A-2 reflects the Advisory Planning Team, consisting of representatives from area organizations and departments for the City of Austin and Austin Independent School District (AISD) that participated throughout the planning process. Table A-3 is comprised of members of a “Stakeholder Working Group” that met on a monthly basis to provide Plan Update input. The public were also invited to participate via e-mail and throughout the planning process. Public outreach efforts and meeting documentation is provided in Appendix E.

**Table A-1. Executive Planning Team**

DEPARTMENTS	TITLE
Office of Homeland Security & Emergency Management	Director
Office of Homeland Security & Emergency Management	Sr. Emergency Plans Officer
Office of Homeland Security & Emergency Management	Accountant
Office of Homeland Security & Emergency Management	Public Information & Marketing Program Manager
Office of Homeland Security & Emergency Management	Public Information Specialist
Office of Homeland Security & Emergency Management	Community Preparedness Program Coordinator
Office of Homeland Security & Emergency Management	Administrative Manager, Administration & Finance Programs

**Table A-2. Advisory Planning Team**

DEPARTMENTS	TITLE
Austin Fire Department	Fire Captain
Austin Fire Department	Fire Adapted Communities Coordinator
Austin/Travis County Health & Human Services Department	Chief Epidemiologist
Austin/Travis County Health & Human Services Department	Epidemiologist

## Appendix A: Planning Team

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DEPARTMENTS	TITLE
Austin Independent School District	Emergency Management Coordinator
Austin Police Department	Sergeant
Austin – Travis County Emergency Medical Services	Division Chief - Emergency Management
Communications & Technology Management	Security
Communications & Technology Management	Information Systems Division Manager
Geographic Information Systems	Programmer Analyst Supervisor
Historic Landmark Commission	Planning
Office of Sustainability	Environmental Program Coordinator
Planning and Development Review Department	Principal Planner
Public Works Department	City Engineer
Public Works Department	Supervising Engineer
Public Works Department	Consulting Engineer
Watershed Protection Department	Program Manager, Environmental Conservation

## Stakeholders

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The following groups listed in Table A-3 represent a list of organizations invited to stakeholder meetings, public meetings and workshops throughout the planning process and include: non-profit organizations; private businesses; and universities. The following list of persons were sent an e-mail and contacted by phone requesting their input in the planning process, and sent an invitation to participate at each of the Stakeholder meetings. Many of the invited organizations and stakeholders participated and were integral to providing comments and data for the Plan Update. For a list of attendees at meetings, please see Appendix E<sup>1</sup>.

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<sup>1</sup> Information contained in Appendix E is exempt from public release under the Freedom of Information Act (FOIA).

**Table A-3. Stakeholder Working Group**

<b>AGENCY</b>	<b>TITLE</b>
Austin Community College (ACC)	Emergency Management Coordinator
Austin/Travis County Integral Care	Coordinator, Disaster Mental Health
Capital Area Council of Governments (CAPCOG)	Director, Homeland Security
Capital Area Council of Governments (CAPCOG)	Homeland Security Planning Coordinator
Capital Area Metropolitan Planning Organization (CAMPO)	Planner
Capital Area Metropolitan Planning Organization (CAMPO)	Air Quality Program Manager
Capital Area Trauma Regional Advisory Council (CATRAC)	Executive Director
Capital Metro	Quality Control Specialist
Red Cross	Disaster Services Chair
Travis County Medical Society	Chief Operating Officer
University of Texas	Director, Campus Security

# Appendix B: Public Survey Results

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Overview .....	1
Public Survey Results .....	2

## Overview

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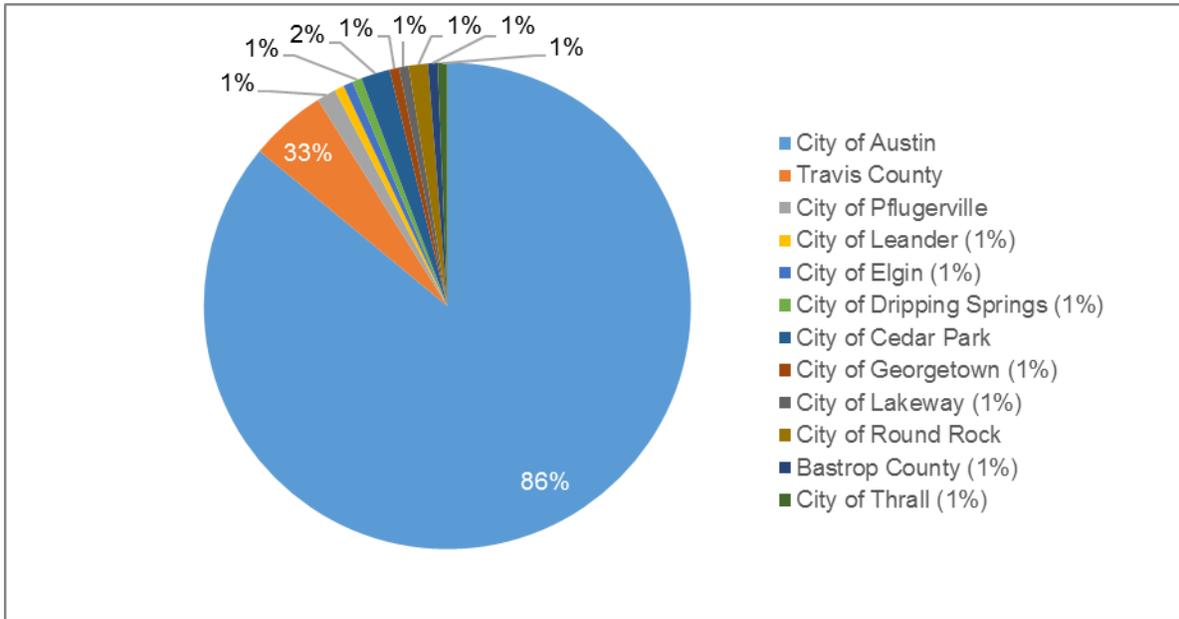
The City of Austin prepared a public survey that requested public opinion on a wide range of questions relating to natural and man-caused hazards. The survey was made available on the City of Austin’s website. This survey link was also distributed at public meetings and stakeholder events throughout the planning process.

A total of 158 surveys were collected, the results of which are analyzed in Appendix B. The purpose of the survey was twofold: 1) to solicit public input during the planning process, and 2) to help the jurisdictions identify any potential actions or problem areas.

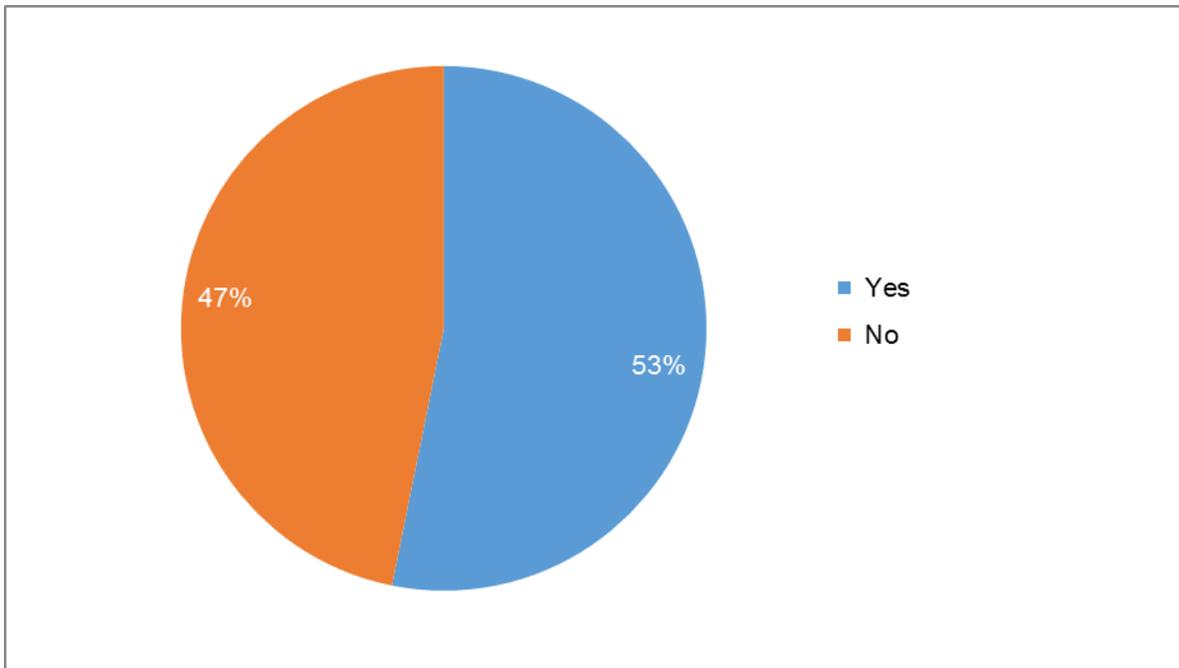
The following survey results depict the percentage of responses for each answer. Similar responses have been summarized for questions that did not provide a multiple-choice answer or that required an explanation.

## Public Survey Results

1. Please state the jurisdiction (city and community) where you reside.



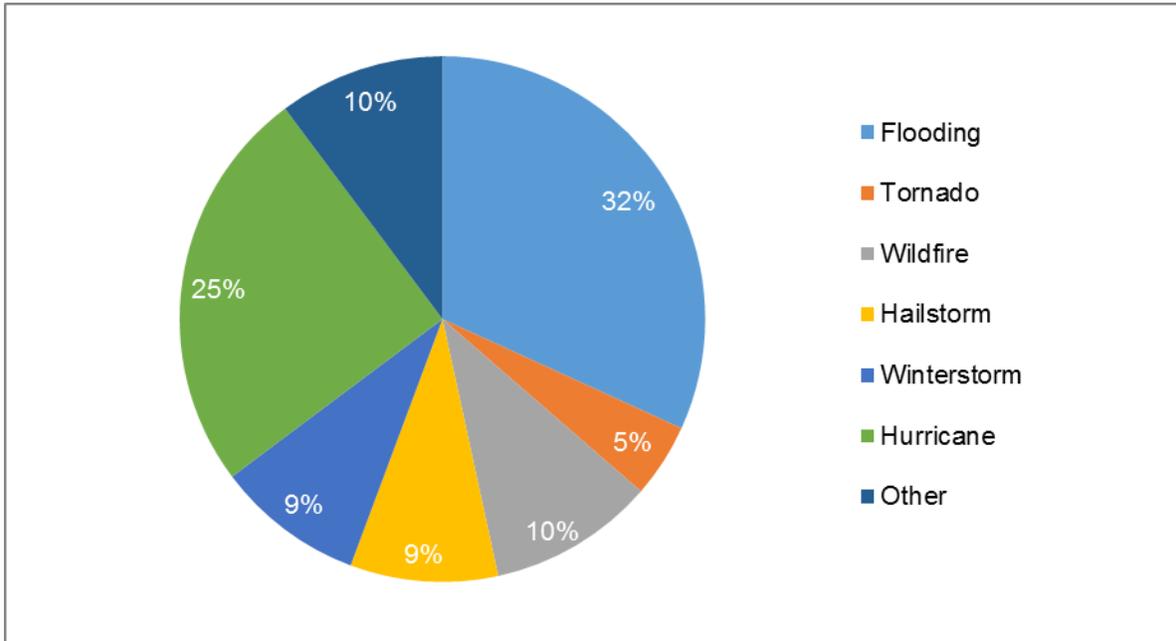
2. A. Have you ever experienced or been impacted by a disaster?



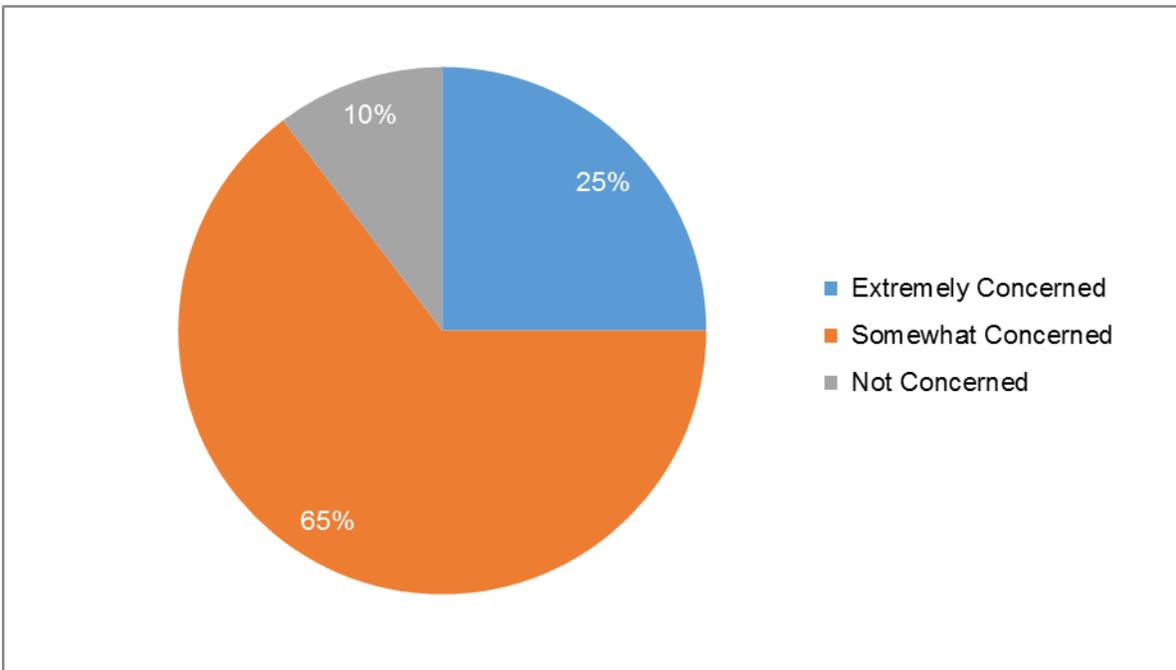
## Appendix B: Public Survey Results

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2. B. If “yes”, please explain:

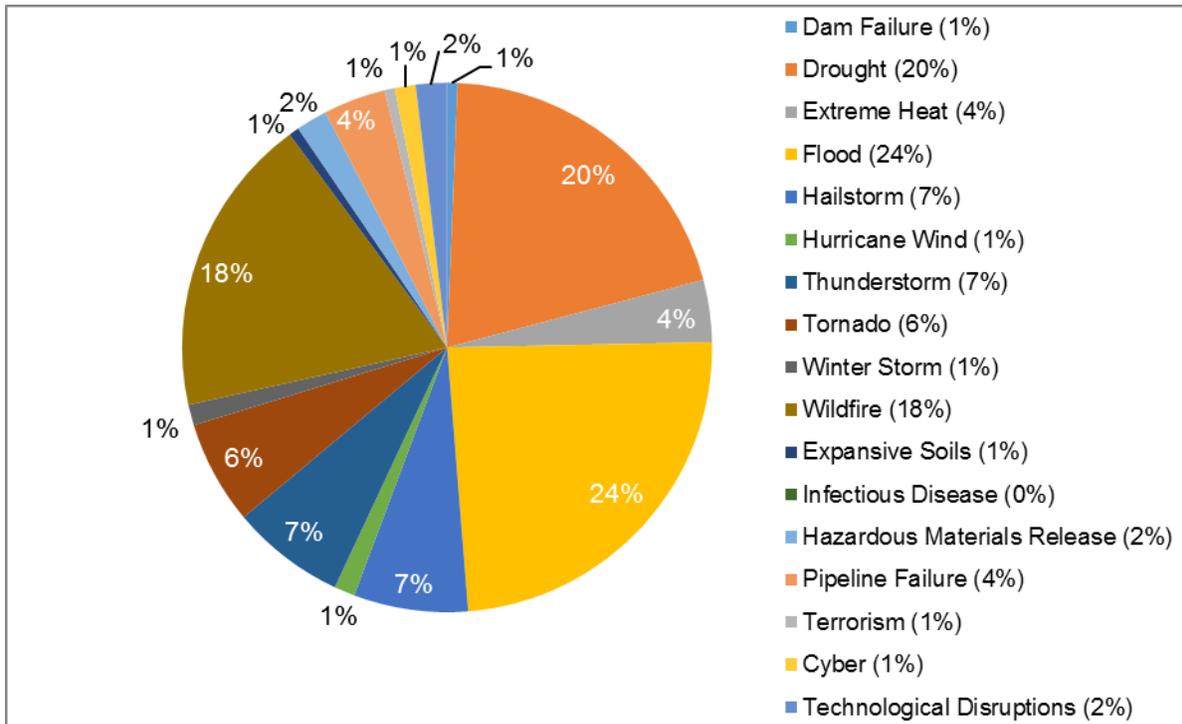


3. How concerned are you about the possibility of your community being impacted by a disaster?

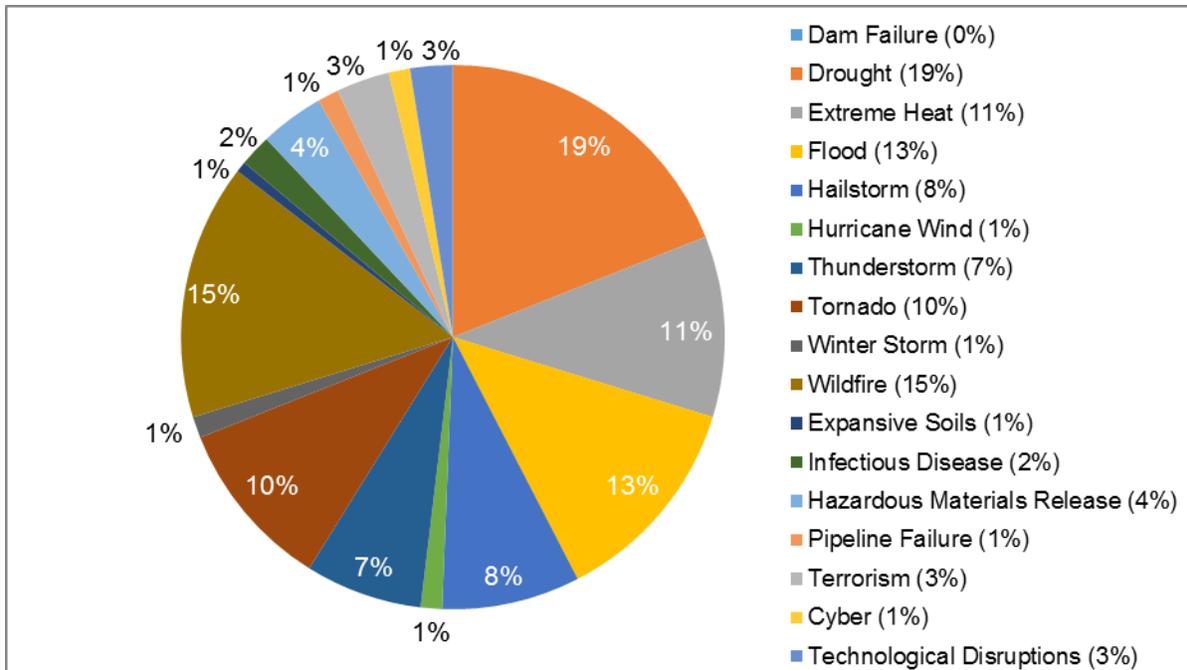


## Appendix B: Public Survey Results

4. Please select the one hazard you think is the highest threat to your neighborhood:



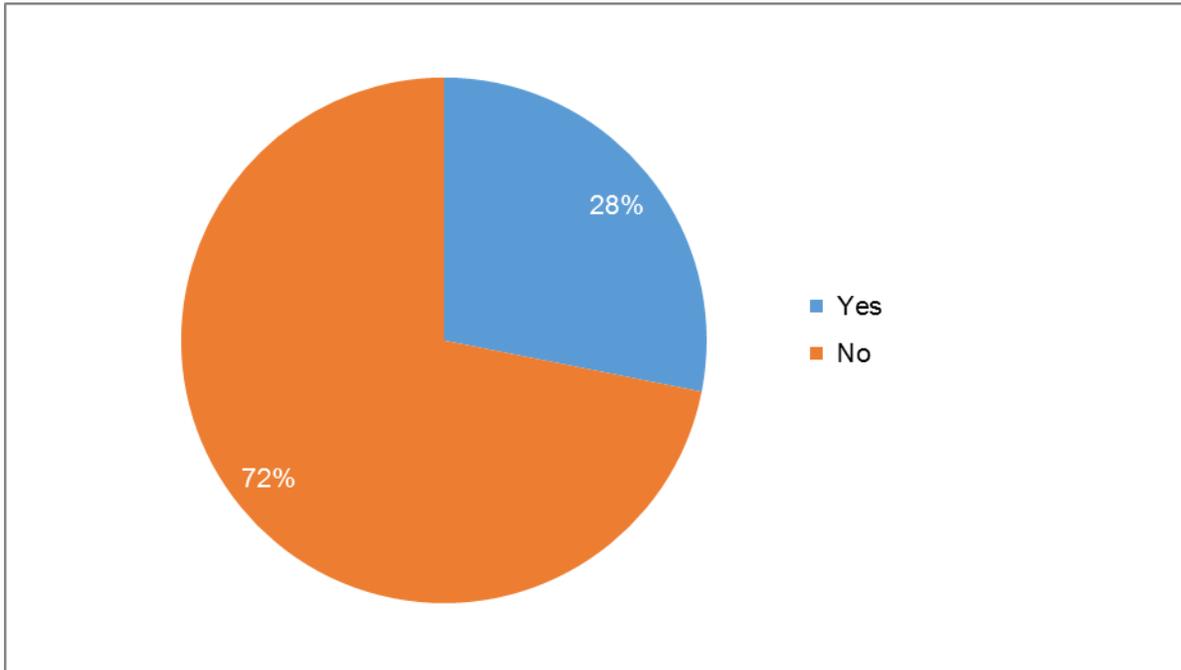
5. Please select the one hazard you think is the second highest threat to your neighborhood:



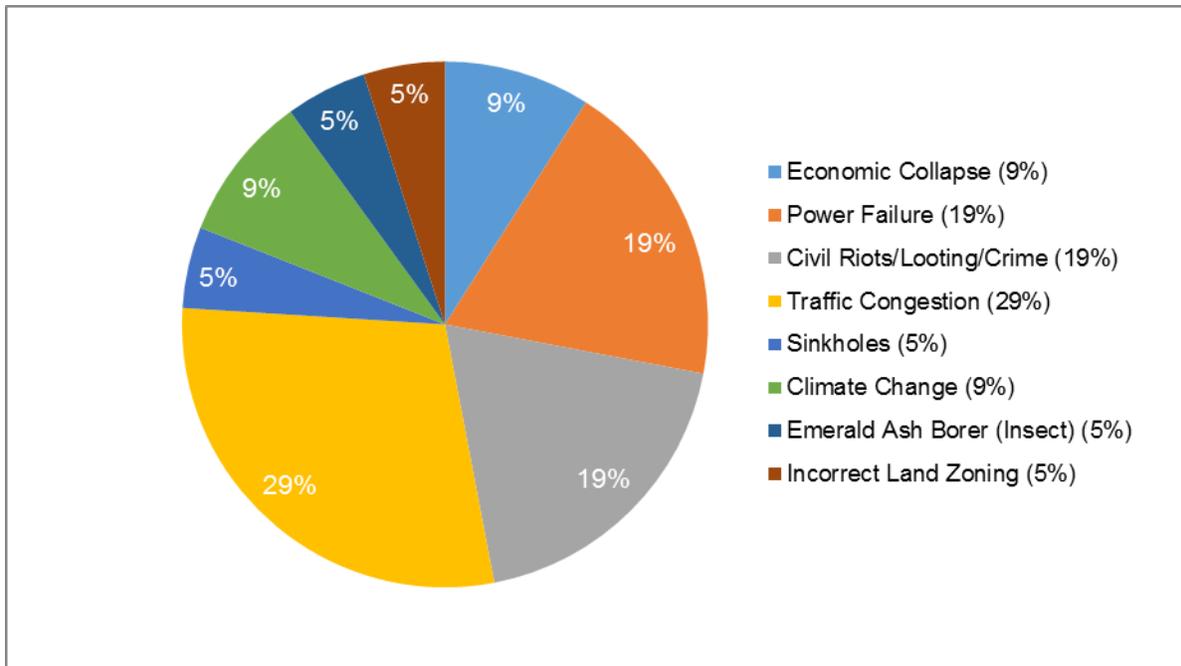
## Appendix B: Public Survey Results

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6. A. Are there hazards not listed above that you think is a wide-scale threat to your neighborhood?



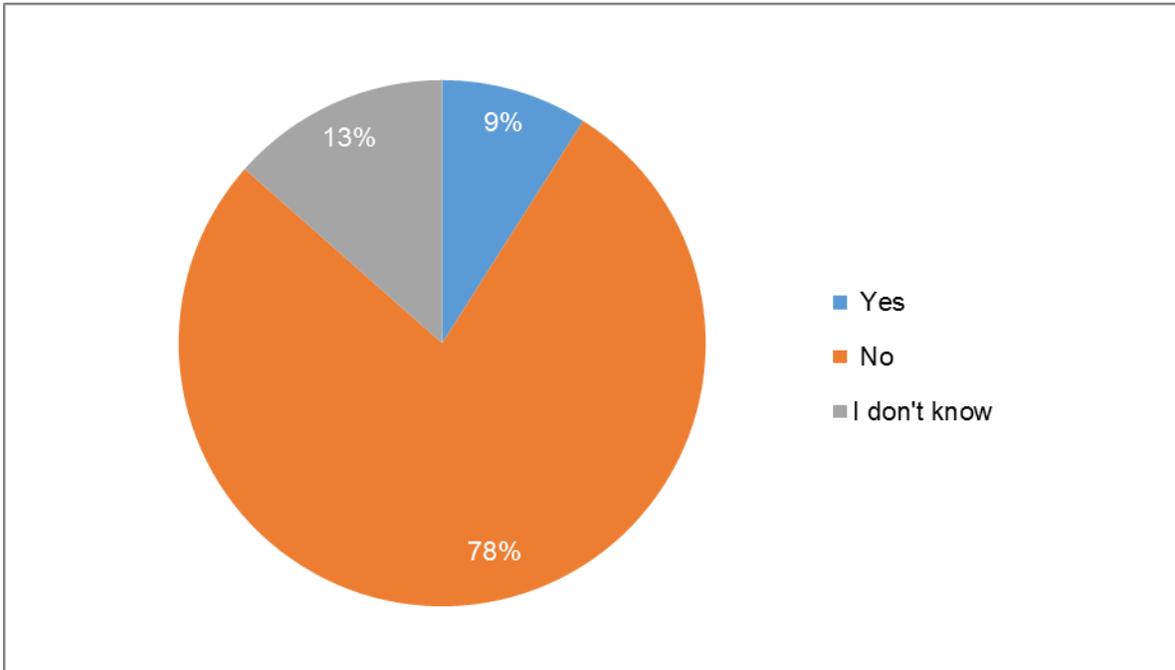
6. B. If "Yes," please explain.



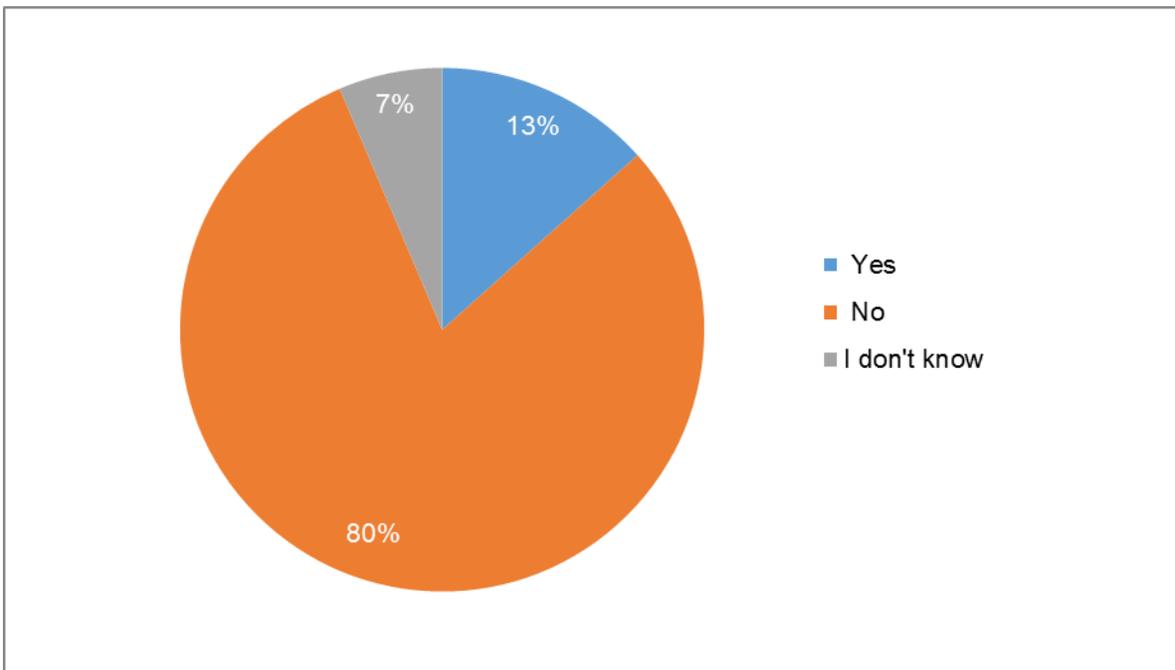
## Appendix B: Public Survey Results

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7. Is your home located in a floodplain?



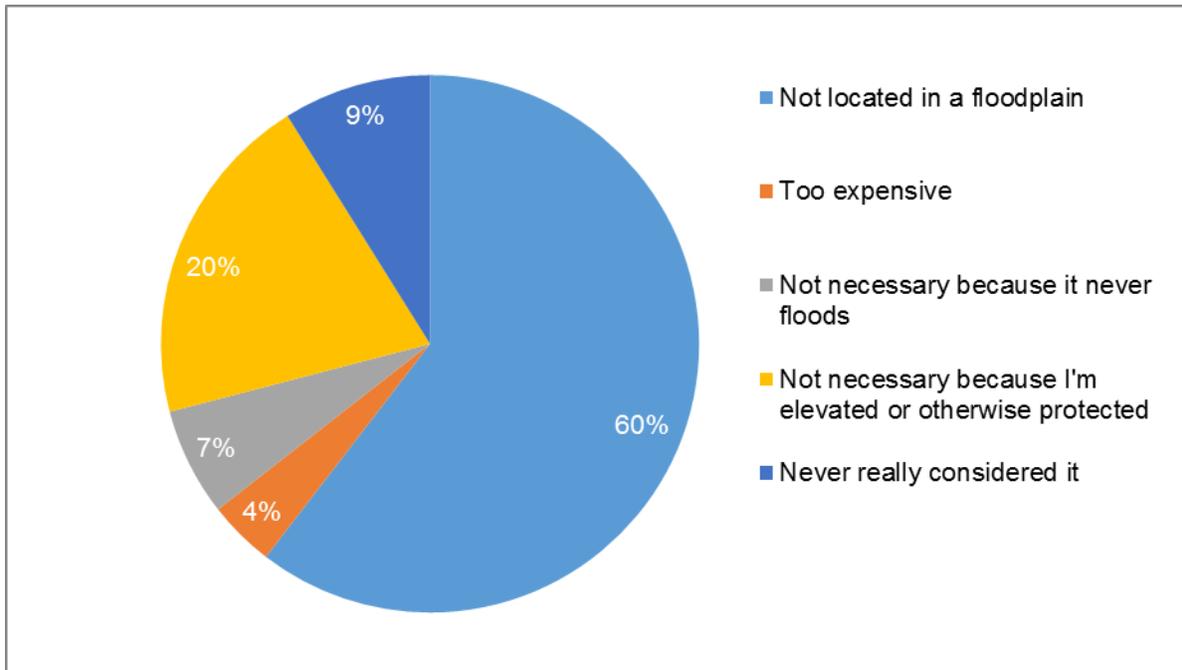
8. Do you have flood insurance?



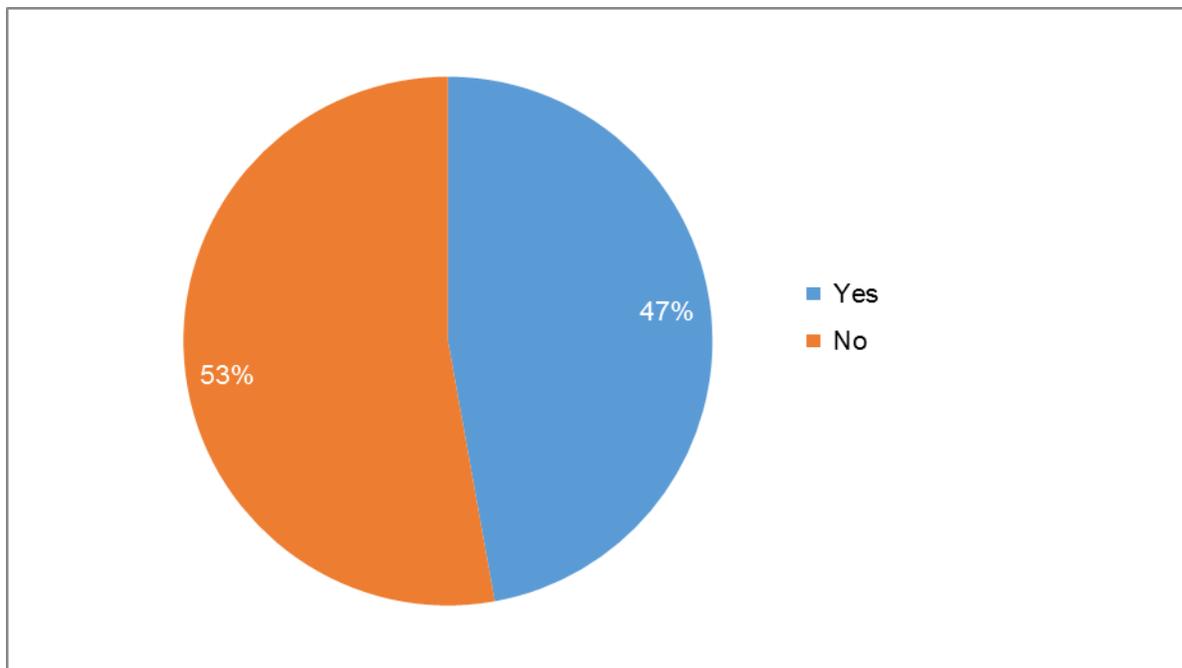
## Appendix B: Public Survey Results

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9. If you do not have flood insurance, why not?



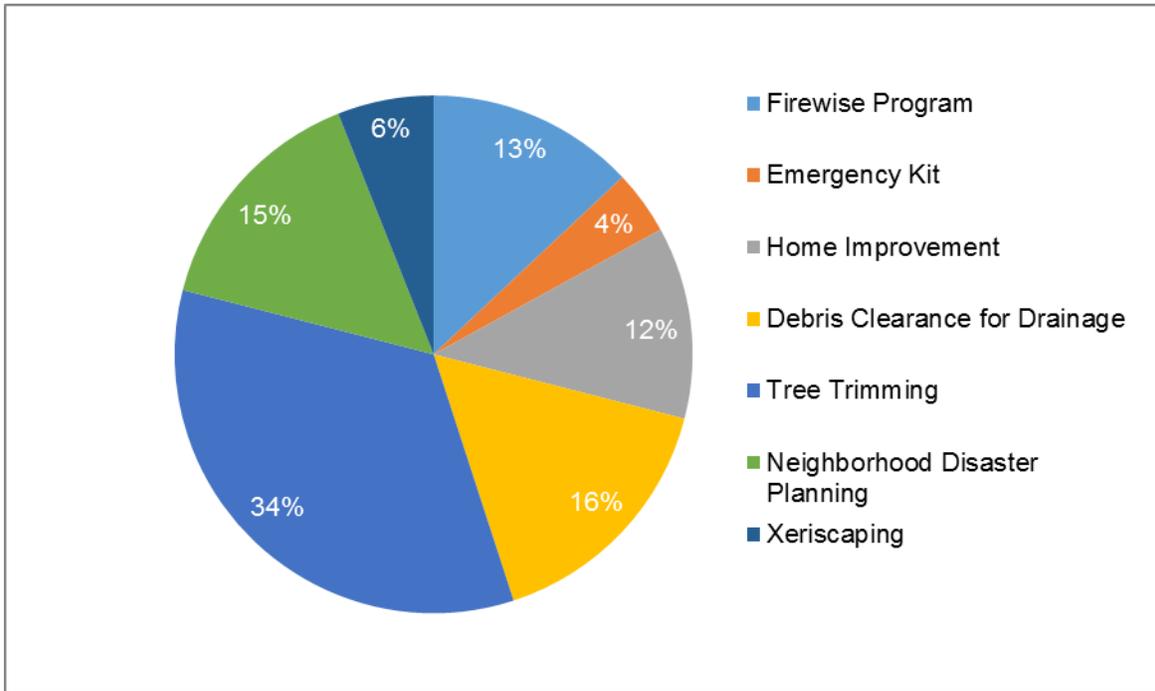
10. A. Have you taken any actions to make your home or neighborhood more resistant to hazards?



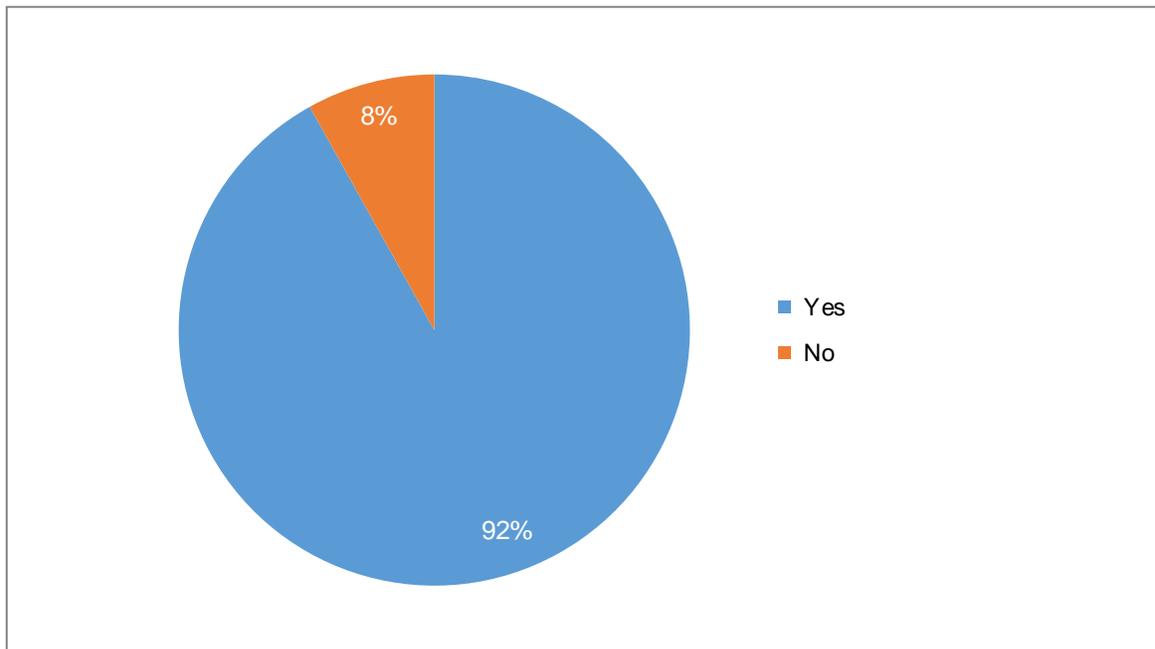
## Appendix B: Public Survey Results

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10. B. What have you done?



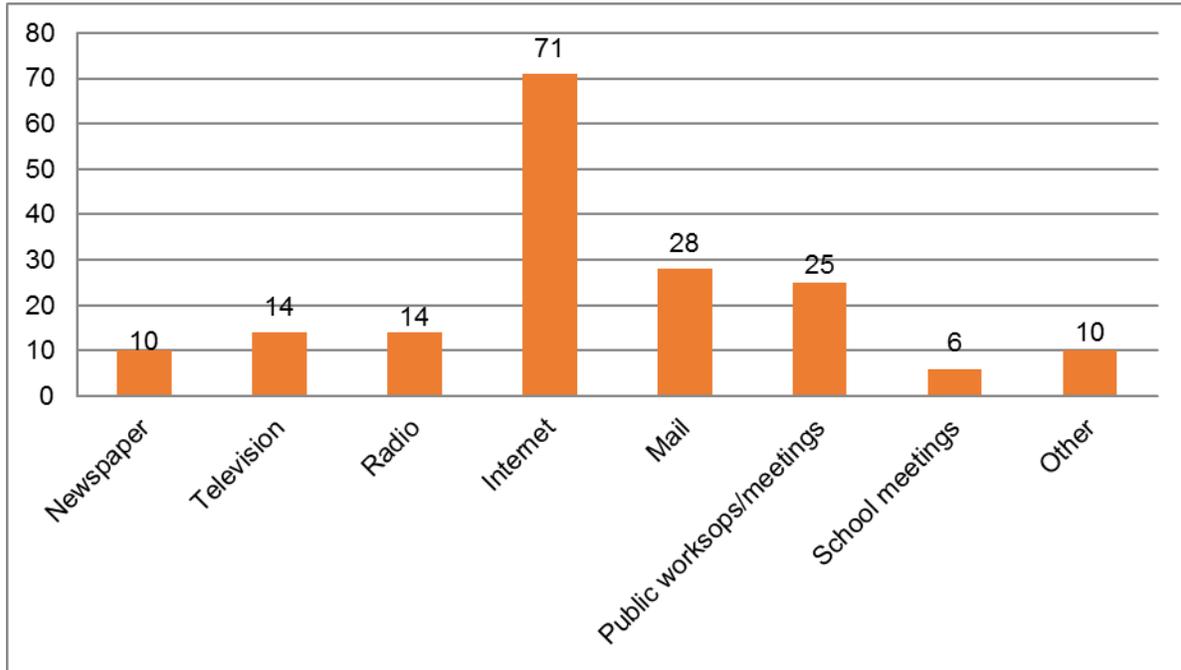
11. Are you interested in making your home or neighborhood more resistant to hazards?



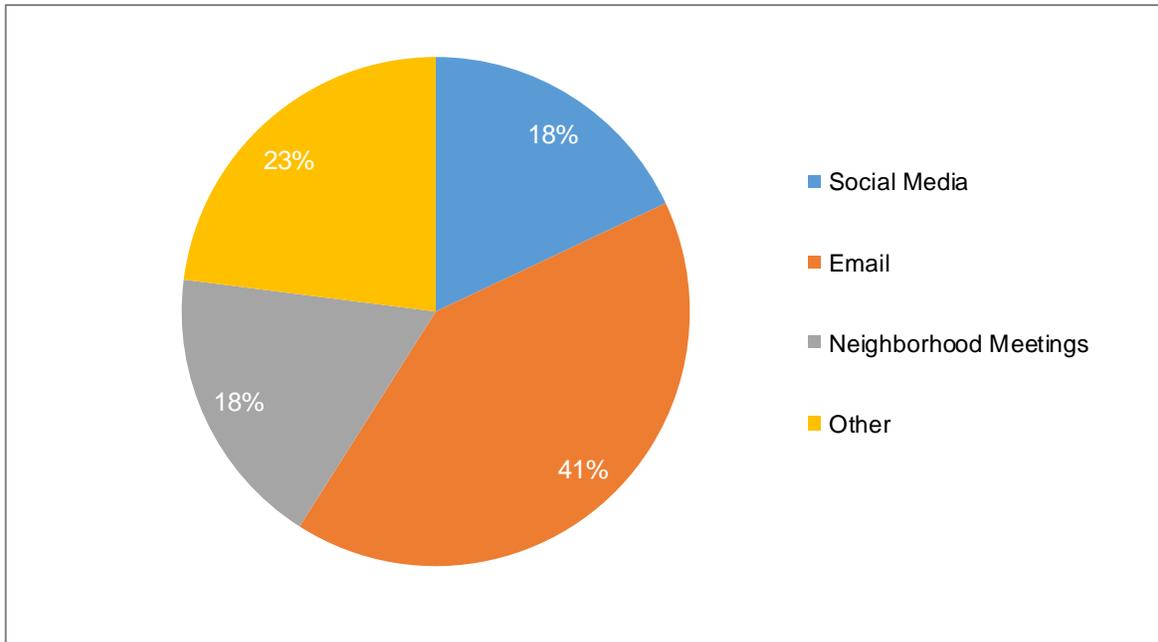
## Appendix B: Public Survey Results

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12. A. What is the most effective way for you to receive information about how to make your home and neighborhood more resistant to hazards?

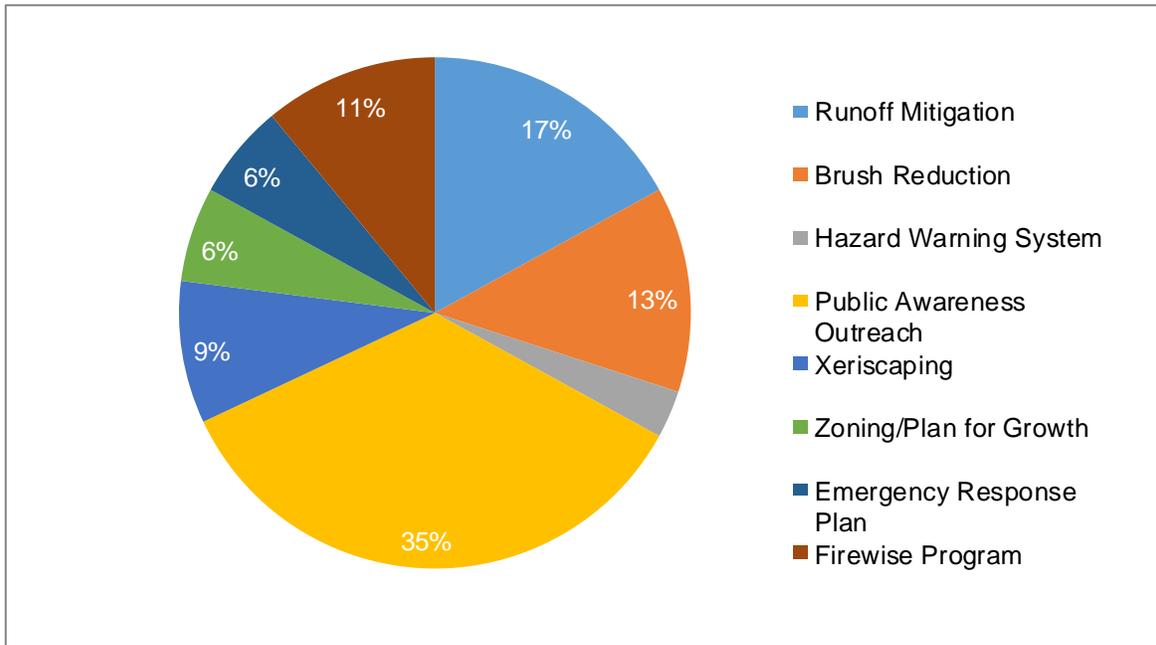


12. B. If other, please specify.

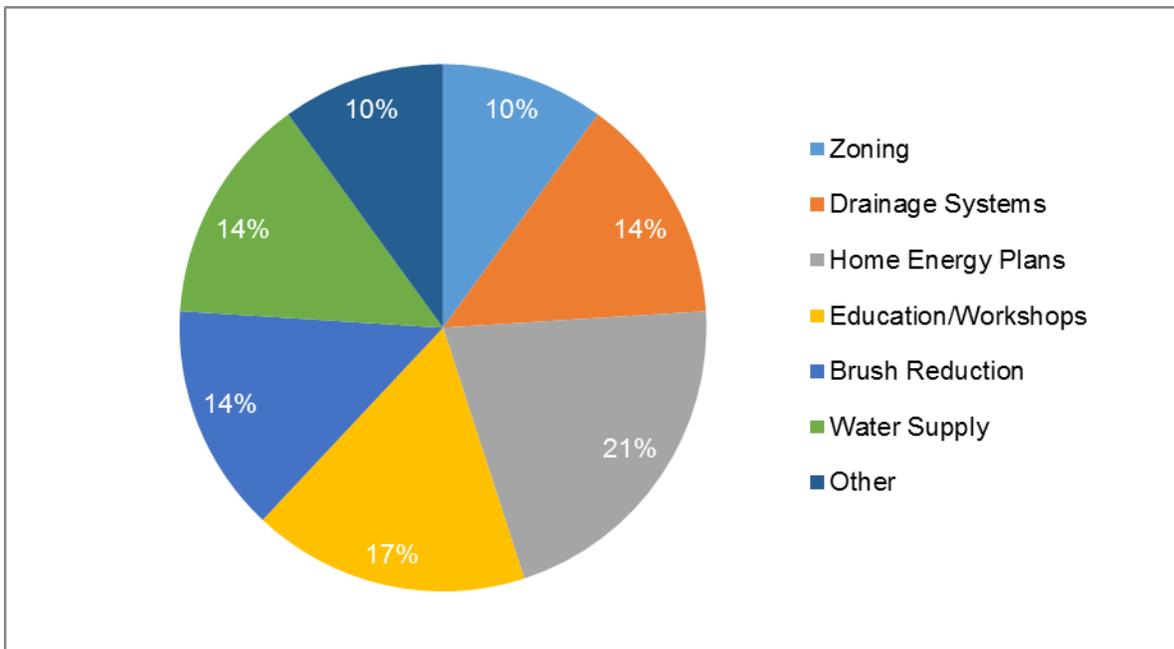


## Appendix B: Public Survey Results

13. In your opinion, what are some steps your local government could take to reduce or eliminate the risk of future hazard damages in your neighborhood?



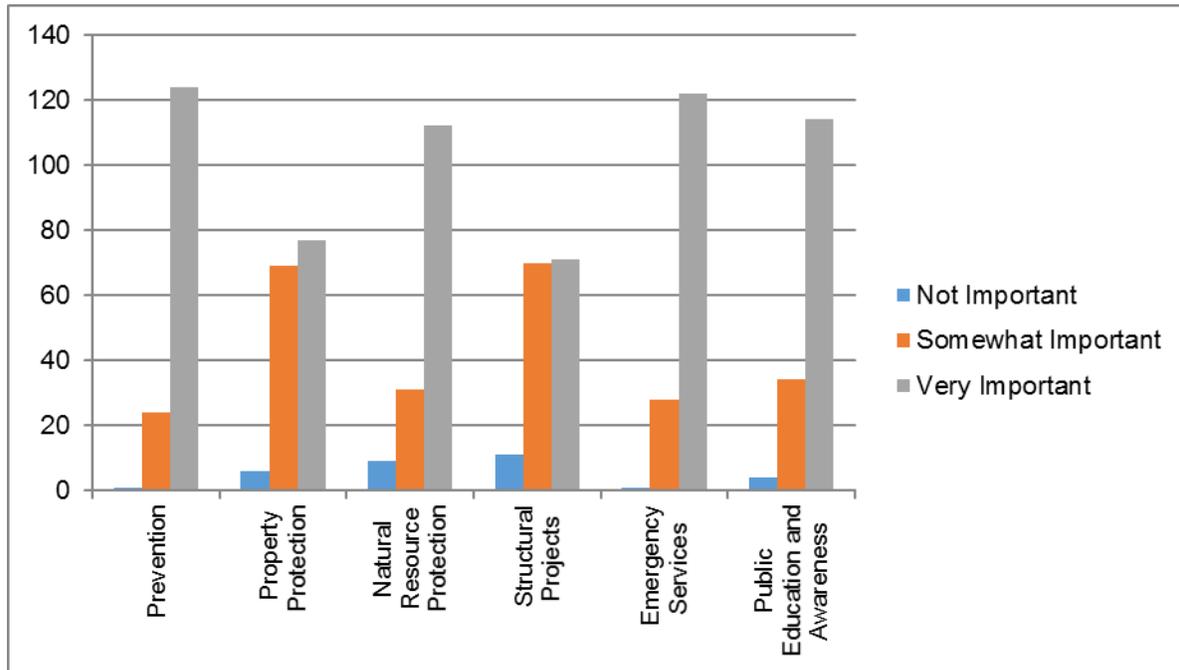
14. Are there any other issues regarding the reduction of risk and loss associated with hazards or disasters in the community that you think are important?



## Appendix B: Public Survey Results

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15. A number of community-wide activities can reduce our risk from hazards. In general, these activities fall into one of the following six broad categories. Please tell us how important you think each one is for your community to consider pursuing.



**Prevention / Local Plans & Regulations** - Administrative or regulatory actions that influence the way land is developed and buildings are built. Examples include planning and zoning, building codes, open space preservation, and floodplain regulations.

**Property Protection** - Actions that involve the modification of existing buildings to protect them from a hazard or removal from the hazard area. Examples include acquisition, relocation, elevation, structural retrofits, and storm shutters.

**Natural Resource Protection** - Actions that in addition to minimizing hazard losses also preserve or restore the functions of natural systems. Examples include: floodplain protection, habitat preservation, slope stabilization, riparian buffers, and forest management.

**Structural Projects** - Actions intended to lessen the impact of a hazard by modifying the natural progression of the hazard. Examples include dams, levees, seawalls detention / retention basins, channel modification, retaining walls and storm sewers.

**Emergency Services** - Actions that protect people and property during and immediately after a hazard event. Examples include warning systems, evacuation planning, emergency response training, and protection of critical facilities or systems.

**Public Education and Awareness** - Actions to inform citizens about hazards and techniques they can use to protect themselves and their property. Examples include outreach projects, school education programs, library materials and demonstration events.

# Appendix C: Critical Facilities

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This Appendix is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

# Appendix D: Dam Locations

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This appendix is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

# Appendix E: Meeting Documentation

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This appendix is **For Official Use Only (FOUO)** and may be exempt from public release under the Freedom of Information Act (FOIA).

# Appendix F: Capability Assessment

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## Overview

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The Planning Team completed a Capability Assessment Survey at the beginning of the planning process. The completed Capability Assessment Checklist, included in Appendix F, provides information on existing policies, plans, and regulations for the City of Austin. Austin Independent School District's (AISD) completed Capability Assessment Checklist is also included in Appendix F.

A Capability Assessment is an integral component of the Plan Update development process. The Capability Assessment serves to evaluate a community's existing planning and regulatory capabilities to support implementation of the Plan's Mitigation Strategy Objectives.

Each community has a unique set of capabilities including policies, programs, staff, funding, and other resources available to accomplish hazard mitigation objectives and reduce long-term vulnerability. The Planning Team identified existing capabilities in each jurisdiction that currently reduce disaster losses or could be used to reduce losses in the future, and capabilities that inadvertently increase risks in the community. .

The City of Austin continuously assesses the impacts of current policies, ordinances, and plans for community safety from hazard risk due to population growth. The City of Austin conducts their assessment through respective planning mechanisms including the Capital Improvements Program, Comprehensive Long-Term Development Plan, and Flood Protection Plan, and other planning strategies. The Capability Assessment was completed considering the safe growth initiative to various sectors of the City of Austin including transportation, environmental management, and land use requirements.

City of Austin Capability Assessment

COMMUNITY CAPABILITY CHECKLIST		
Planning/Regulatory Tool	In Place	Under Development
Hazard Mitigation Plan	X	
Comprehensive Land Use Plan	X	
Stormwater Management Plan/Ordinance		X
Emergency Operations Plan	X	
Capital Improvements Plan	X	
Floodplain Management Plan	X	
Flood Response Plan	X	
Historic Preservation Plan		
Continuity of Operations Plan	X	
Evacuation Plan	X	
National Flood Insurance Program (NFIP)	X	
NFIP Community Rating System	X	
NFIP Floodplain Ordinance	X	
Building Code	X	
Fire Code	X	
Other Plans - CodeNEXT update to Watershed Protection and Development Ordinances		X
<b>Administrative and Technical Capability</b>	<b>Yes</b>	<b>No</b>
Planners	X	
Engineers	X	
Emergency Manager	X	

## Appendix F: Capability Assessment

COMMUNITY CAPABILITY CHECKLIST		
Floodplain Manager	X	
Personnel skilled in Geographic Information Systems (GIS)	X	
Resource development staff or grant writers	X	
<b>Financial Resources</b>	<b>Yes</b>	<b>No</b>
Capital Improvement Programming	X	
<b>Financial Resources</b>	<b>Yes</b>	<b>No</b>
Community Development Block Grants (CDBG)	X	
Stormwater Utility Fees	X	
Development Impact Fees	X	
Partnering Agreements or Intergovernmental Agreements	X	
Other: Regional Stormwater Management Program	X	
Other: Public Assistance Grant DR-4159-TX 2013 October Floods: Hazard Mitigation 406	X	
Other: National Disaster Resilience Competition	X	

AISD Capability Assessment

COMMUNITY CAPABILITY CHECKLIST		
Planning/Regulatory Tool	In Place	Under Development
Hazard Mitigation Plan	X	
Comprehensive Land Use Plan	X	
Stormwater Management Plan/Ordinance		
Emergency Operations Plan	X	
Capital Improvements Plan	X	
Floodplain Management Plan		
Flood Response Plan		
Historic Preservation Plan		
Continuity of Operations Plan		X
Evacuation Plan	X	
National Flood Insurance Program (NFIP)	X	
NFIP Community Rating System	X	
NFIP Floodplain Ordinance	X	
Building Code	X	
Fire Code	X	
Other Plans/Codes – ADA Compliance, National Electrical Code, Plumbing Codes, International Energy Conservation Code	X	
<b>Administrative and Technical Capability</b>	<b>Yes</b>	<b>No</b>
Planners	X	
Engineers	X	

## Appendix F: Capability Assessment

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COMMUNITY CAPABILITY CHECKLIST		
Emergency Manager	X	
Floodplain Manager		X
Personnel skilled in Geographic Information Systems (GIS)	X	
Resource development staff or grant writers	X	
<b>Financial Resources</b>	<b>Yes</b>	<b>No</b>
Capital Improvement Programming	X	
Community Development Block Grants (CDBG)	X	
Partnering Agreements or Intergovernmental Agreements	X	